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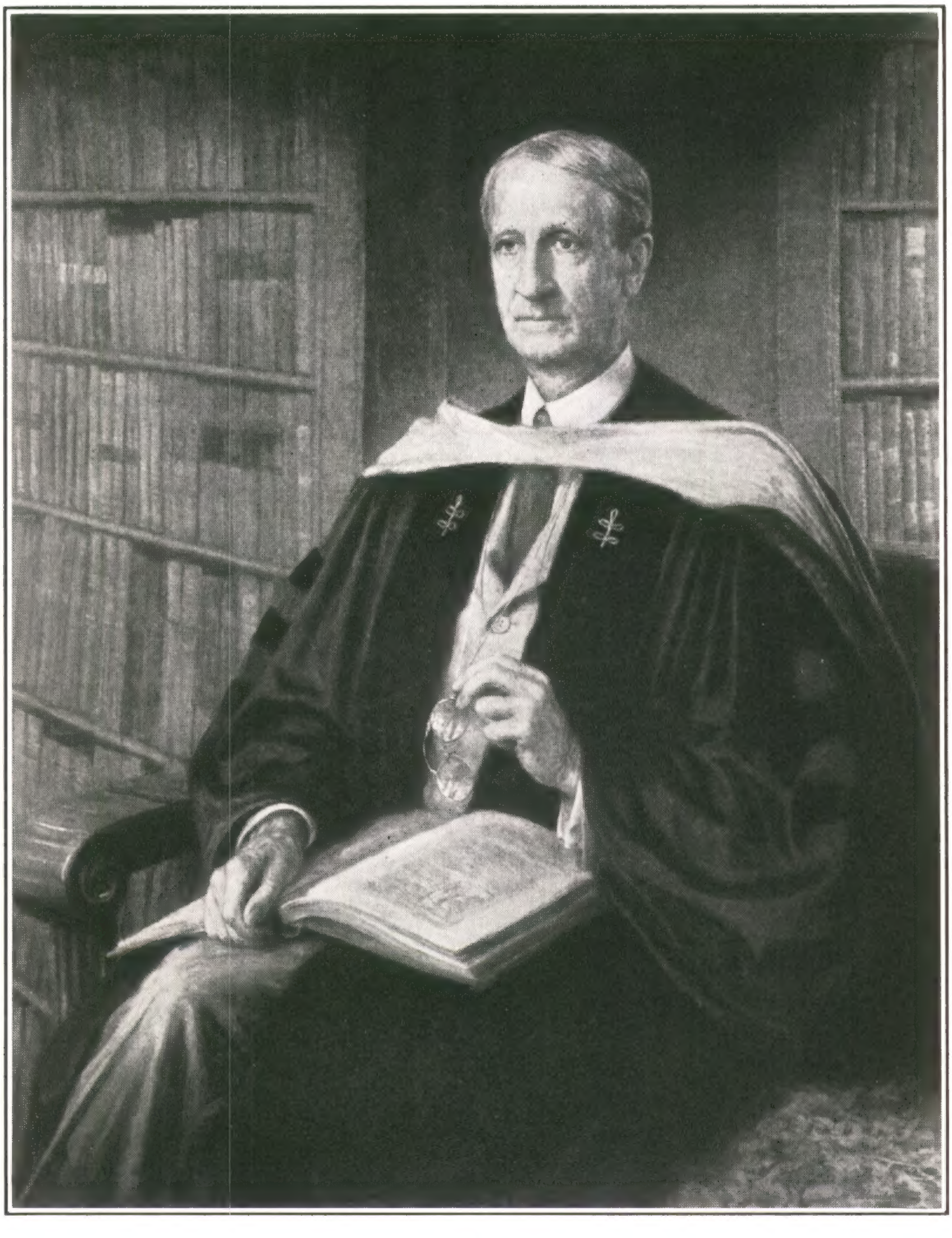

From a painting by Blanche Ames, 1946

OAKES AMES
1874–1950

A YEAR has now elapsed since Professor Oakes Ames, who served the Botanical Museum as its principal administrative officer from 1923 to 1945, first as Curator, later as Supervisor, and finally as Director, passed away on April 28, 1950. In the intervening months the members of the staff of the Botanical Museum have been engaged in completing this volume of the *Botanical Museum Leaflets* which, soon after his death, it was decided to dedicate to his memory.

The choice of the *Leaflets* as the medium for a memorial volume was a quite natural one since Professor Ames himself founded the *Leaflets* and since they represent not only his diverse botanical interests, but also his insistence upon high quality in paper, printing, composition and illustration. Professor Ames deplored the trend toward cheaper publications. "A scholarly scientific paper," he said, "is a jewel worthy of a proper setting."

The entire staff of the Botanical Museum has shared in the production of this volume, and the papers which it contains represent quite accurately the extraordinary diversity of Professor Ames' botanical interests. Of the fourteen papers, ten are concerned with taxonomy and three of these with the taxonomy of the orchids, Professor Ames' lifelong special interest. His second professional love, economic botany, is represented by eight papers of which five are also taxonomic and three are in ethnobotany, a field which the Botanical Museum, at Professor Ames' instigation, has fostered in recent years. Paleo-

botany, a traditional interest of the Museum and one which Professor Ames was instrumental in reviving, is represented by one significant paper. Professor Ames' sustained interest in the course in Economic Botany, which he taught for many years, finds representation in "The Story of Pan Chewing in India" which was submitted as a term paper by a student enrolled in the course.

Only one facet of Professor Ames' botanical career fails to find expression in this volume; his broad philosophical outlook upon the Orchidaceae, a plant family to whose study the major part of his life was devoted. Happily this interest had previously been treated in "Orchids in Retrospect," a collection of his essays on the Orchidaceae which was published in 1948 by his colleagues to commemorate the fiftieth anniversary of his service to Harvard University. This book also contains a biographical sketch.

With deep respect for the memory of Oakes Ames, with constant admiration for the standards of excellence for which he stood, and with a firm purpose of perpetuating the sound traditions which he established, the members of the staff of the Botanical Museum dedicate this memorial volume.

Cambridge, Massachusetts
April 28, 1951

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ERRATA

page 25, line 31
for ramanentibus, read remanentibus

page 115, line 33
for amazónica, read amazónico

page 134, line 30
replace the comma with a period

page 150, lines 7, 10 and 15
for Matthews, read Mathews

page 195, line 31
for *Areca*, read *Acacia*

page 242, line 23
for **Kraenzlin**, read *Kraenzlin*

page 249, lines 5 and 9
for *E.*, read *A.*

page 252, line 32
for H. Perrier, read Perrier de la Bâthie

page 253, line 32
for Excell, read Exell

page 281, line 7
for Coons, read Coon

Plate XXXI
for 4, read 5; for 5, read 6; for 6, read 7; add 4 to figure at the left of 3

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DEGRADATION OF PLANT REMAINS IN ORGANIC SEDIMENTS

BY

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ONE of the least understood but at the same time fundamental processes which operates in nature is the alteration of plant residues into economically important substances such as peat, lignite and coal. In its broadest terms this degradation of plant substance must be regarded as a phase of the major organic cycle of carbon. It is obvious, however, that in "geologically permanent" large-scale accumulations of organic complexes such as the fossil fuels, we are concerned essentially with major deviations from, rather than participation in, the carbon cycle.

In a certain sense, therefore, the study of the accumulation of plant residues and their subsequent alteration comprise an area of botanical investigation which lies between microbiology on the one hand and the geological and chemical aspects of sedimentation on the other. Microbiological studies of degradation, however, are more often centered on specific organisms or on the metabolic products of their activity, rather than on an analysis of the effects produced on various naturally occurring substrata. In addition, emphasis in microbiological studies is quite logically placed more on the degradative aspects than on the accumulative aspects of the organic cycle.

The ultimate fate of organic residues in nature is determined in large part by diverse factors of the environment: physical, chemical and biological. The vast bulk of plant and animal remains is quite rapidly reduced, through complex energy-releasing processes, to simpler organic and inorganic compounds; and conversely, through complex energy-consuming processes these are re-incorporated into the tissues of living organisms. Conspicuously active and effective in the biochemical decomposition changes are the fungi and bacteria.

The rate of degradation due to microbiological activity is ordinarily most rapid in a warm, moist, highly aerobic environment. Favorable conditions are probably fulfilled to the greatest degree on or just below the surface of the soil. The ratio of accumulation versus degradation in the soil environment provides variable amounts of the so-called humus or organic component of the soil. If the environment is excessively wet, and more particularly if the availability of oxygen becomes deficient, the rate of degradation of plant tissues is greatly reduced. Such conditions reach their extreme in stagnant, poorly drained and relatively shallow basins such as swamps and bogs. Under such circumstances the accumulative phase exceeds the degradative phase and there results a gradual accretion of modified plant residues. In discussing the degradation and preservation of plant tissues it is therefore essential that reasonable distinction be drawn between environments in which aerobic microbiological changes may proceed at a rapid rate, as in soil, and subaqueous environments of submergence and oxygen deficiency. This distinction seems to be of fundamental importance since the character of the degradative changes is greatly influenced, if not primarily determined, by the degree of these contrasting conditions of the biological and physical environment. It might almost be said that

at one extreme of the spectrum of organic decay there are the various processes which operate in the soil and lead to the formation of soil organic matter, while at the other extreme there are the conditions of anaerobic submergence. In all cases microbiological processes induce physical and chemical changes in the plant tissues incorporated in the substratum, but the degree of change and the duration of the change vary profoundly.

Some understanding of the degradation of plant tissue is essential to a satisfactory interpretation of many types of plant fossils, since the variously modified remains of plant parts constitute the bulk of our knowledge of the paleontological record of plant life. For the most part these source materials are fragments or occasionally entire plants which fortuitously entered basins of deposition in which degradative processes were retarded and eventually inhibited. Under certain unusual and poorly known conditions the infiltration of mineral salts in solution and their subsequent precipitation resulted in an unusually perfect preservation of the original structure of the plant tissues. This is well known in the case of many fossil woods and other plant parts which are silicified or calcified. The sequence of events *preceding* mineralization, however, appears to have been basically similar to that which prevails in any accumulation of plant fragments, as in the formation of peat and other carbonaceous sediments. There seems to be no evidence that special environmental conditions have been responsible for the "biological fixation" of mineralized plant fragments, i.e., their unusual retention of organic structure. Rather, the unusual conditions have been those leading to precipitation of the mineral matrix itself, as in the calcareous nodules, or "coal balls," of certain coal seams, and the formation of silicified nodules.

In anticipation of the evidence to be shown later in

this paper, it may be stated here by way of a generalization that: (1) *The anaerobic degradation of the plant cell wall in sediments involves fundamentally similar structural changes in all plant tissues*; and (2) *These degradative changes are directly related to basic physical, chemical and structural features of the cell wall.*

The significant features in the general pattern of structural change in the anaerobic degradation of wood were described in a previous study of numerous woods recovered from an archeological site in Boston, Massachusetts (Bailey and Barghoorn, 1942). Since the publication of this earlier study, a far wider range of material from various geological horizons has been examined anatomically and, in part, microchemically. A more detailed description of these studies is in the course of publication (Barghoorn 1949),[1] but it seems desirable to review here the salient features of these investigations and their relation to various paleobotanical and anatomical problems as well as their possible bearing on dating archeological remains.

In wood of varying age, entombed in mineral or organic sediments, and permanently submerged, there occurs a gradual reduction of the amount of cellulose contained in the original unmodified cell walls. Depending on the availability of oxygen during degradative changes, and its effect on microbiological activity, a variable degree of "humification" results. Stumps of trees, submerged by sudden inundation, commonly occur embedded in peat deposits, yet may show little evidence of the "humification" so characteristic of the peat. For example, in the fresh water peats and "buried forests" of the

[1] As a section of the second monograph on the archeology, geology, stratigraphy and paleobotany of the Boylston Street Fishweir (Papers of the Robert S. Peabody Foundation for Archeology).

New England coast, now under tidal influence, numerous stumps and roots may be recovered which retain to a great extent the color of the original wood, yet whose tissues are altered to a soft, almost cheese-like consistency. Similarly, the permanently submerged basal parts of wooden piles driven into sediments in both marine and fresh water environments show a peripheral zone of degraded wood which may be relatively unchanged in color or gross appearance. Archeological remains of wood preserved in the anaerobic environment of estuarine sediments have been shown to undergo almost no "humification" or pronounced change from their original color (Bailey and Barghoorn, 1942). On the other hand, plant fragments from autochthonous peats or other organic accumulations in which aerobic degradation has played an important part almost invariably exhibit pronounced changes in color and the other physical and chemical modifications which feature the concept of "humification" (Waksman, 1938).

However, all degraded plant tissues, whether "humified" *or visibly* unaltered, are characterized by a significant reduction of their original cellulose, the extent of loss of cellulose being fundamentally an index of the degree of chemical and physical degradation. In view of these facts, which are well supported by numerous anatomical and chemical investigations (Mitchell and Ritter, 1934; Jurasky, 1938; Cartwright and Findlay, 1943; Waksman, 1938; Jahn and Harlow, 1942; etc.), it is of interest to examine in detail the structural changes which occur during degradation of the cell wall.

In order to orient the significance of these anatomical changes it is desirable to note briefly certain fundamental aspects of the structure of plant cell walls. Among higher plants the presence of a cell wall is the most conspicuous visible feature in the organization of tissues, organs and,

in general, of the entire plant body. The cell wall is composed initially, in its development from pre-existing cells, of a *primary wall*. This primary wall is a cellulosic layer (or series of layers) which ordinarily increases in surface area and may vary in thickness during the growth and enlargement of the cell. After growth and enlargement have ceased, a *secondary wall* may be formed, always internal to the primary wall. In many plant tissues, particularly in reproductive organs, secondary walls are not formed, and, in such cases the primary wall may become thick and conspicuous, comprising the bulk of the cell wall. In the cell walls of wood and woody plant tissues, however, thick secondary walls are ordinarily developed, the major topographic and structural feature of such tissues being their greatly thickened secondary walls.

The secondary walls of cells in woody tissues consist, except in certain cases, of three morphologically distinct layers or lamellae (Bailey and Kerr, 1935; Bailey, 1938; 1940). The innermost and outermost of these lamellae comprise relatively thin aggregations of cellulosic wall substance in which the crystalline cellulose aggregates tend to be oriented more or less transversely, or in helices of low pitch. The central and ordinarily thickest layer of the secondary wall, on the other hand, is composed most commonly of crystalline cellulose which tends to be oriented more nearly vertically, or in helices of steep pitch (Bailey, 1940). All three cellulosic lamellae may be infiltrated to varying degrees with encrusting substances such as lignin, terpenes, resins or other "protective" chemical complexes which retard biological and chemical degradation.

In the anaerobic degradation of wood it has uniformly been found that a consistent sequence of degradative changes occurs. This sequence shows a significant and fundamental relation to the lamellar structure of the cell

wall. The incidence of degradation of the lamellae is in the following order:

(1) Central layer of the secondary wall
(2) Innermost layer of the secondary wall
(3) Outermost layer of the secondary wall
(4) Primary wall[1]

Progressive stages in the deterioration of the cell wall are shown in Plates I–IV. Three outstanding features may be noted in these thin sections of degraded wood: (1) a reduction of the major portion of the secondary wall to a granular, virtually amorphous residue; (2) the retention of a structurally intact cell wall "layer" or "membrane" which corresponds in position to the primary wall; and (3) the presence of isolated or contiguous groups of cells whose secondary walls are relatively unaltered.

That the conspicuous granular remnants of degraded wall layers are essentially lignin residues may be demonstrated by their total extraction during delignification (compare Plate I, Figs. 1, 2 and 3 with Plate III, Figs. 1, 2 and 3). The visibly intact, persistent layers, or occasionally entire cell walls, are truly cellulosic, as may be shown by their brilliant birefringence in the microscope when viewed between crossed Nichols. Birefringence in the thinner cellulosic residual layers is greatly accentuated by delignification.

Because of their extremely tenuous character, certain structural residues, such as those in Plate I, Figs. 1, 3 and 4 and Plate III, Figs. 1, 2 and 3, might be assumed to consist solely of primary walls. The composition of these tenuous "membranes," however, can be shown to com-

[1] The term primary wall refers here specifically to the *wall layers* of individual contiguous cells exclusive of the true intercellular substance which is often erroneously, and confusingly, included as a part of the "primary wall" (Kerr and Bailey, 1934).

prise *five layers* viz., the outermost secondary wall layer and the primary wall of the two contiguous cells plus the true intercellular substance between the adjacent primary walls. The five-layered structure of these tenuous "membranes" is revealed by their relation to the pit border of bordered pit-pairs. This relationship is most easily observed in the late wood tracheids of coniferous woods, as shown in Plate III, Figs. 1, 2 and 3 (also compare Plate III, Fig. 3 with Fig. 5). The pit border is solely a structural feature of the secondary wall. It is apparent, therefore, that the tenuous innermost layer of the pit border, shown in Plate III, Figs. 2 and 3, is the resistant outermost or first formed layer of the secondary wall. Hence, it may be deduced that the persistent fraction of the cell wall in these tissues consists in large part of the remaining outermost layers of the secondary wall of two adjacent cells, including of course the retained and still more tenuous primary walls and true intercellular substance. That the persisting or visibly intact cell wall is actually a very minor part of the original unmodified secondary wall is shown in thin sections in which cells possessing intact secondary walls are intermingled with cells exhibiting extensively degraded secondary walls (Plate I, Figs. 1 and 2 and Plate III, Fig. 1). The reason or reasons for the retention of the *entire* secondary wall in certain cells which are in direct contact with others in which these wall layers are extensively degraded remain obscure.

It should be emphasized in connection with its greater resistance to degradation that the outermost or first formed layer(s) of the secondary wall possesses quite different staining reactions, optical properties and physical behavior from those of the broad central layer. The first formed layer is more heavily lignified than the central layer and shows far less tendency to swell in strong mineral acids, such as 72 per cent sulfuric acid or 40 per cent

hydrochloric acid. It is probable, therefore, that significant chemical as well as physical differences exist between the first formed and the subsequently formed lamellae of the secondary wall. In these respects the outermost layer of the secondary wall more closely resembles the primary wall than it does the later formed lamellae of the secondary wall.

The existence of a pronounced difference in the rate of degradation of the various cellulosic layers of a single cell wall presents a seeming paradox in the interpretation of cellulose decomposition. Two questions immediately arise: (1) what are the factors, biological or chemical, which cause the decomposition; and (2) what substance or substances impart such differential resistance to degradation within the cell wall itself? The fact that differential degradation of wall layers is not an isolated phenomenon, but instead a fundamental feature in the anaerobic decomposition of plant tissues emphasizes the significance of these questions and their bearing on the problem of cellulose decomposition in general.

In a previous study by the author these questions have been discussed in some detail, particularly with reference to environmental conditions and the possible causes of degradation (Barghoorn, 1949). It has been proposed, though not proven, that the degradation of wood deeply submerged in marine sediments is probably due in large part to the hydrolytic breakdown of cellulose rather than directly to microbiological attack.[1] It is probable, although again not proven, that the relatively high concentration of hydrogen sulfide (and associated hydro-sulfuric acid) in many carbonaceous marine sediments is responsible in part for the gradual chemical

[1] This conclusion does not question the apparently well established evidence confirming the existence of anaerobic bacteria at considerable depths in peat deposits (Thiessen and Strickler, 1934; Waksman, 1930).

hydrolysis of cellulose. Whether similar or comparable environmental factors are operative in terrestrial carbonaceous sediments remains to be determined.

The general uniformity of degradation in wood after prolonged submergence in sediments of diverse composition attests to the operation of a widely diffused set of factors which result in the gradual hydrolysis of the less resistant cellulosic fractions. In the case of the archeological remains previously noted it was found that wooden stakes, driven through successive strata of marine silt, peat and glacial blue clay, were uniformly degraded throughout, the physical condition of the stakes being identical in their entire length regardless of the surrounding media and the duration of submergence (Bailey and Barghoorn, 1942). Hence, the hydrolytic degradation of the cellulose appears to have progressed at an approximately similar rate regardless of the matrix. Similarly, entire stumps, logs or branches which have been submerged for periods exceeding thousands of years may become uniformly degraded and softened throughout, exhibiting no significant differences between their peripheral and interior parts. Occasionally the innermost portions of larger stumps may retain a core of intact or incompletely degraded wood. When freshly removed from its matrix the wood often shows little or no compression failure, nor even any significant change from its original volume; upon drying, however, it contracts excessively. Anatomical and chemical study shows that such degraded wood consists primarily of the lignin residue of the original wood substance, its cellulose content being reduced to a small fraction of the original, frequently on the order of three to five per cent. The persisting fraction of the cellulose, significantly, however, is found restricted primarily to those more resistant layers of the cell wall previously described. All of this evidence

indicates that gradual hydrolysis of the cellulosic matrix of the cell walls has proceeded at a rather uniform rate, the degradative changes first affecting the peripheral zone and slowly extending inward.

Ultimate complete degradation of the cellulosic framework of the wood cell wall may be delayed for enormously longer periods than have elapsed since the beginning of post-glacial time (Mitchell and Ritter, 1934; Jurasky, 1938; Barghoorn and Bailey, 1938). Recent extensive studies of lignites of Tertiary age show that in various genera of hardwood trees the lignitized wood retains from two and one half to six per cent of its original carbohydrate fraction, the major constituent of this fraction being degraded cellulose. In the same deposit lignitized fruits and seeds may show retention of as much as 45 to 50 per cent of their original carbohydrate fraction, predominantly cellulose.[1]

One aspect of the general problem which is of considerable theoretical, if not practical, interest is that dealing with the causes of selective retention of cellulose in certain lamellae of the cell wall. Two possible explanations for the selective degradation of cellulose are immediately apparent: (1) the presence in the cellulosic matrix of substances which effectively retard the hydrolysis (either microbiological or chemical) of cellulose; and (2) actual chemical differences in the cellulosic framework of the more resistant lamellae of the cell wall.

The first of these possible explanations finds much support from various observations and lines of evidence. For example, it has been established quantitatively by several investigators that the degree of lignification correlates with resistance to decay in wood and other woody tissues (Waksman and Cordon, 1936; Olson, Peterson

[1] Unpublished data from analyses of the Brandon lignite of Brandon, Vermont.

and Sherard, 1937; Virtanen, Koistinen and Kiuru, 1938). Additional evidence confirming the "protective" effect of lignin has been obtained by the author in a series of experiments utilizing a species of the cellulolytic bacterium *Cytophaga*. In a series of liquid cultures each containing mineral salts, filter paper and thin sections of various woods (*Pinus*, *Sequoia* and the hardwood *Trochodendron*), it was found that the filter paper was completely broken down within a period of a week, whereas the various wood sections were unaffected after six weeks incubation.

In addition to lignin, other normal constituents of the cell wall may serve to inhibit biological degradation of cellulose, viz., resins, terpenes and tanniniferous substances. Differential resistance of cell wall layers might logically be ascribed, therefore, solely to the effect of these encrusting "protective" substances of which lignin is undoubtedly the most significant in anaerobic degradation of woody tissues. In further support of this explanation of the selective breakdown of the cell wall, it should be emphasized that the most resistant layer of the secondary wall, viz., the outermost or first formed layer, is often far more heavily lignified than the broad central layer (Bailey and Kerr, 1935). Moreover, the primary wall, the most resistant of all the lamellae of the cell wall, is intensely lignified (Ritter, 1925; Kerr and Bailey, 1934).

The effect of degrees of lignification in different lamellae of the cell wall often produces striking morphological effects on the mode of attack of wood by various fungi. Fungi belonging to diverse genera of the Pyrenomycetes and Fungi Imperfecti commonly degrade wood by dissolving the central and often the innermost layers of the secondary wall, but leaving the outermost layer and the primary wall visibly unaltered (Bailey and Vestal, 1937;

Barghoorn, 1944). Early stages of this restricted breakdown of the cellulosic matrix are illustrated in Plate IV, Figs. 1 and 2, showing the invasion of wood by fungal hyphae. Similar in nature are the effects of certain brown rots on the degradation of wood. These are shown, perhaps more diagrammatically in Plate IV, Figs. 3 to 6. In some cases the entire secondary wall (with the exception of the tenuous outer layer) is completely removed, leaving a structural residue consisting of five layered "membranes" similar in composition to those previously described from wood degraded under anaerobic conditions (compare Plate III, Figs. 1 and 3 with Plate IV, Figs. 3, 4, 5 and 6).

All of this evidence indicates that the deterioration of wood is primarily a process of removal of cellulose, the rate of loss being, in many cases, significantly correlated with the degree of lignification or the protection of cellulose by other substances.

A fundamental exception to this relatively simple explanation, however, may be determined by an anatomical study of plant remains extracted from peats. In deflocculated, and subsequently delignified ("dehumified"), samples of fibrous peats innumerable delicate plant fragments are often released. In grass and sedge peats these fragments are most commonly cellulosic epidermal residues of roots and rhizomes. Microscopic examination often reveals preservation of even the most delicate epidermal structures such as root hairs, root cap cells and epidermal papillae (Plate VI, Figs. 1 to 6). Although these tenuous residues of roots have retained minute anatomical features in certain parts, they are devoid of their thick walled fibrous or conductive tissues (Plate VI, Figs. 1 and 2). However, in *undelignified* preparations of *comparable roots* there may be found degraded remnants of the originally thick walled conducting tissues

and fibers, whose secondary walls have been reduced to granular residues. The secondary wall residues and other degraded or "humified" decomposition products are readily extracted (with little or no deleterious action on the remaining cellulose) by means of various techniques utilizing sodium chlorite as the delignifying agent (Barghoorn, 1948).

Studies of fibrous peats of varying post-glacial age consistently show a cellulosic residue, often representing a very small fraction of the original sample. The amount of cellulose recovered is much influenced by the technique employed in lignin extraction: direct repeated chlorination or treatment with acidified hypochlorite solutions may result in oxidation and partial (or complete) solution of the persisting degraded cellulose residues. Anatomically, however, *structural cellulosic residues preserved in peats consist for the most part of thick, previously unlignified primary cell walls.* Tissues possessing thick, lignified secondary cell walls may undergo extensive degradation in environments in which even delicate cellulosic cell walls are incompletely broken down. In recognition of these facts it seems a paradox of note that the most delicate tissues of various plant organs may be far more resistant to anaerobic degradation than are cells or tissues possessing thick, frequently heavily lignified secondary cell walls.

In view of these observations, which are consistently supported by anatomical studies as well as by chemical analyses of degraded plant remains, it seems quite difficult to interpret selective degradation of different portions of the plant cell wall except in terms of chemical differences in the successively formed lamellae of the cell wall. In other words, *the exceptional resistance of the primary cell wall to degradation may be due to chemical rather than physical "protective" factors.* Such an inter-

pretation is strongly supported by the fact that primary wall cellulose often persists after degradation of the cellulose of heavily lignified layers of the secondary wall. For this and other reasons it seems difficult to interpret selective degradation of cellulose in different parts of the plant cell wall except in terms of chemical differences and resistance to hydrolysis in successively formed lamellae.

The persistence of the primary and occasionally the outermost layers of the secondary cell wall is strikingly shown in many silicified woods. Not uncommonly, silicified wood, regardless of geologic age, contains unusual amounts of organic residues, occasionally present to such an extent that the demineralized wood may be embedded, sectioned and stained much as living tissue (Arnold, 1931; 1941). In such material of diverse groups of plants which may range in age from Devonian to Tertiary, there is no cellulose remaining; it seems likely that silicification took place at a time when degradation of the cell wall had not yet passed the stage of the partial retention of a cellulosic structural residue. In other words, the cellulosic framework of the tissues was retained for a sufficient length of time to allow preservation of structure before silicification began. After or during the silicification process the remaining cellulose was lost from the tissue, leaving a modified but coherent lignin residue. This modified and silicified residue simulates the original cellulosic residue of anaerobically degraded wood (compare Plate I, Figs. 1 and 3 and Plate II, Figs. 2 and 3 with Plate V, Figs. 1, 2 and 5).

Whether the greater resistance to degradation of the cellulosic lamellae of the primary wall and the outermost secondary wall of plant cells is due to intrinsic chemical factors or primarily to physical protection by extraneous non-cellulosic substances cannot be determined without further coördinated histological and chemical study.

However, it is evident from anatomical and microchemical investigation that resistant fractions of cellulose occur in many organic deposits of various geologic ages and that these resistant fractions are directly related to predetermined structural features of the plant cell wall; hence they have their basis in the biochemistry of growth and differentiation of the cell wall.

Since the ultimate loss of cellulose in plant remains may, under certain conditions, be delayed to varying degrees for immense periods of geologic time, it is apparent that simple generalizations can scarcely be made regarding the complex processes of degradation in organic sediments as a whole. Chemical analyses of peat and humus have supplied data showing gross trends in the chemical alteration of plant remains in deposits (Waksman, 1938). However, such empirical analyses do not correlate microchemical and anatomical aspects of degradation, and in general they interpret natural decomposition of plant remains in terms of plant substance rather than in terms of the complex organization of cells and tissues. It is significant, however, that the less favorable the conditions are for microbiological processes, the greater is the retention of the original cellulose in plant accumulations. With increasing geologic age, total loss of cellulose occurs through "coalification" and various changes associated with the transformation of plant residues into higher rank coals. The problems of the earlier stages of cellulose degradation in anaerobic environments and of the processes of "humification" in general are in need of further coördinated anatomical, microbiological and chemical studies. Such investigations will be essential before a clear understanding of the major biological and chemical changes occurring between plant source materials and their geologic accumulation in the form of fossil fuels will be possible.

Summary

1. Alteration of plant residues under anaerobic conditions in organic sediments is a fundamental but inadequately known phase of the accumulation of carbon in nature.

2. Details of anatomical changes during decomposition of plant tissues are of importance in the morphological interpretation of many structurally preserved plant fossils.

3. Anaerobic degradation of the plant cell wall involves certain basic structural changes which appear to be similar in all plant tissues; these changes are directly related to basic physical and chemical features in the organization of the cell wall.

4. Degradation of the cell wall, either aerobically or anaerobically, is characterized primarily by loss of cellulose; the removal of cellulose most frequently follows a uniform sequence determined by the lamellar organization of the wall.

5. The incidence of degradation of cell wall lamellae in lignified tissues occurs in the following sequence:
    1. Central layer of the secondary wall
    2. Innermost layer of the secondary wall
    3. Outermost layer of the secondary wall
    4. Primary wall

6. The greater resistance of certain lamellae of the cell wall may be logically assigned to protection of the cellulosic framework by lignin and other "encrusting" substances. The persistence of unlignified primary walls in fibrous peats, however, cannot be explained by such mechanical protection, and demands an alternate explanation.

7. It is proposed, although it cannot be demonstrated within the scope of this study, that the greater resistance to hydrolysis of the primary wall and the outer secondary wall layer is due to chemical differences in the organization of the cellulosic matrix, rather than solely to a physical relation with lignin and other protective complexes.

8. The ultimate loss of cellulose in organic deposits may be delayed for periods measured in terms of geologic time, as shown by its presence in lignites of Tertiary and older age. The rate of loss, however, is greatly influenced by the initial biological conditions of deposition as well as by subsequent environmental changes accompanying "coalification."

9. Mineralization of plant remains apparently often occurs at a stage when cellulosic structural residues are still retained. Infiltration and precipitation of minerals, such as silica and calcium carbonate, occasionally cause a "fixation" of structure which, in mineral form, retains a large measure of biological detail. Such petrifactions may or may not retain a rather high percentage of the original, though chemically modified, organic matter during subsequent geologic change.

10. Many aspects of the problem of "humification" and "coalification" of plant residues are known only in empirical terms. An adequate understanding of these complex processes will necessitate extensive coördinated microbiological, anatomical and chemical investigation.

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ILLUSTRATIONS

EXPLANATION OF THE ILLUSTRATIONS

PLATE I. FIG. 1. Transverse section of the wood of a submerged white pine stump, age about 2000 years, showing differential degradation of the cell wall. Note the presence of some intact cell walls, others incipiently degraded and many cells in which the secondary wall is largely reduced to a lignin residue occupying the center of the lumen. ×70.

FIG. 2. Transverse section of the same material showing incipient degradation of the secondary wall of an isolated tracheid (center) surrounded by cells in which the secondary wall has been largely degraded. ×170.

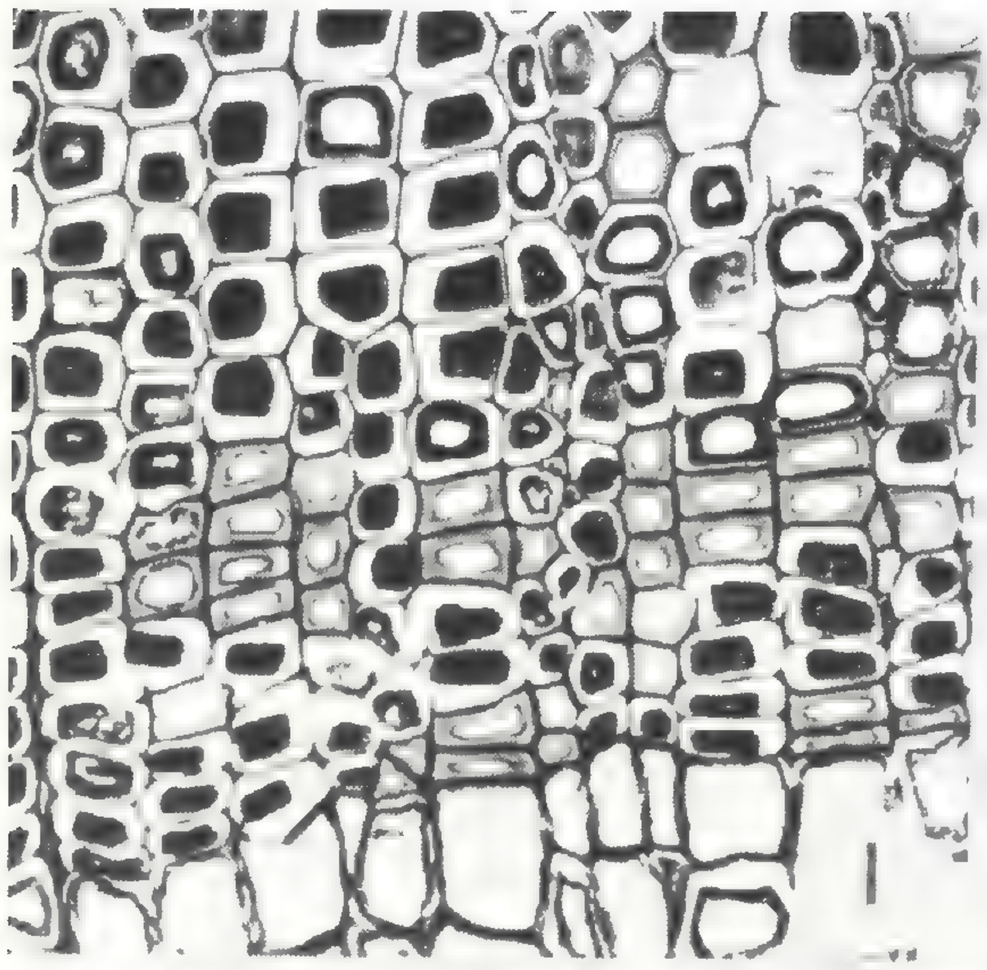
FIG. 3. Transverse section of the same, but more highly magnified. Note the discrete mass of the "coagulated" remnants of the major part of the secondary wall in the center of each cell. ×870.

FIG. 4. Tangential longitudinal section of the same material. The dark, heavily stained amorphous material represents the degraded remains of the central and inner layers of the secondary walls. ×100.

FIG. 5. Transverse section of a spruce pile, submerged in marine silt for 100 years. This section from the outer rings of the pile shows incipient degradation of the central and inner layers of the secondary wall. ×500.

FIG. 6. Transverse section from a different part of the white pine stump shown in Fig. 1. Note the complete breakdown of the central and inner layers of the secondary wall and the retention of the primary wall and the outermost layers of the secondary wall. ×500.

Plate I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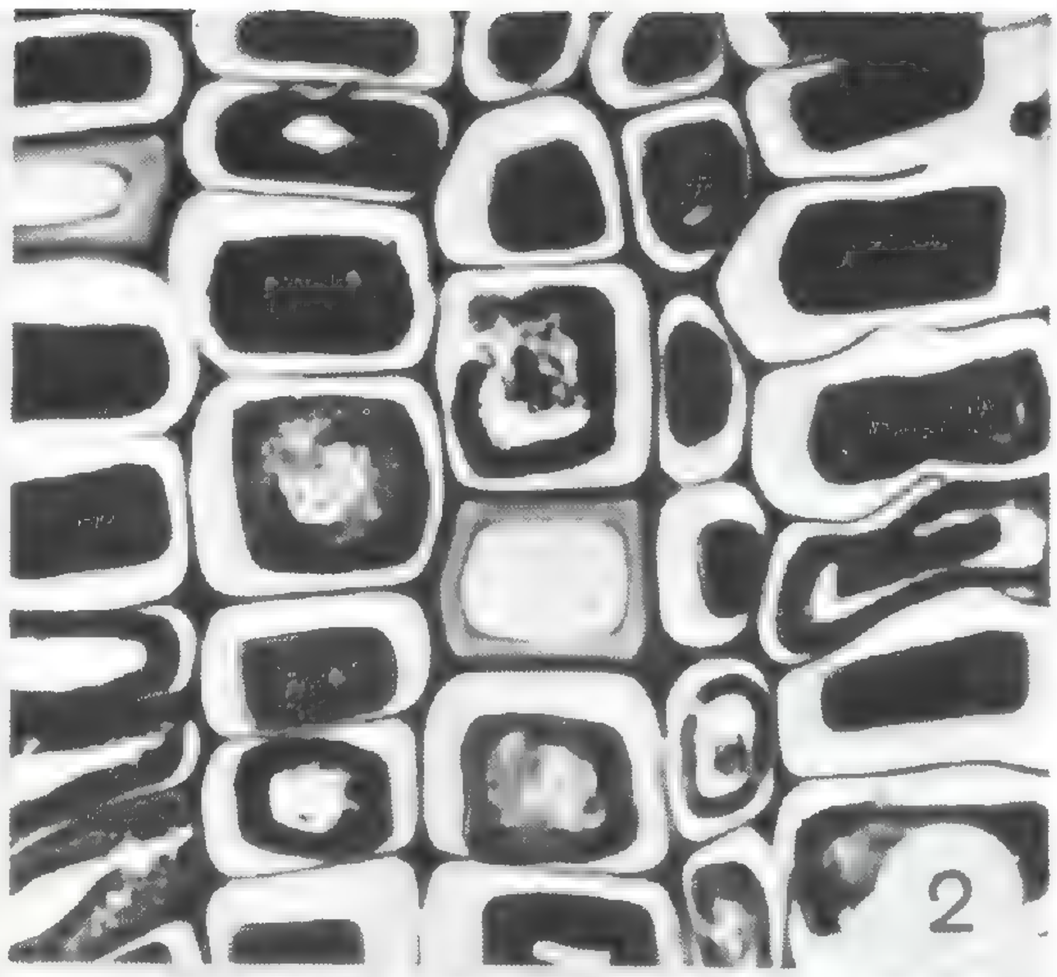
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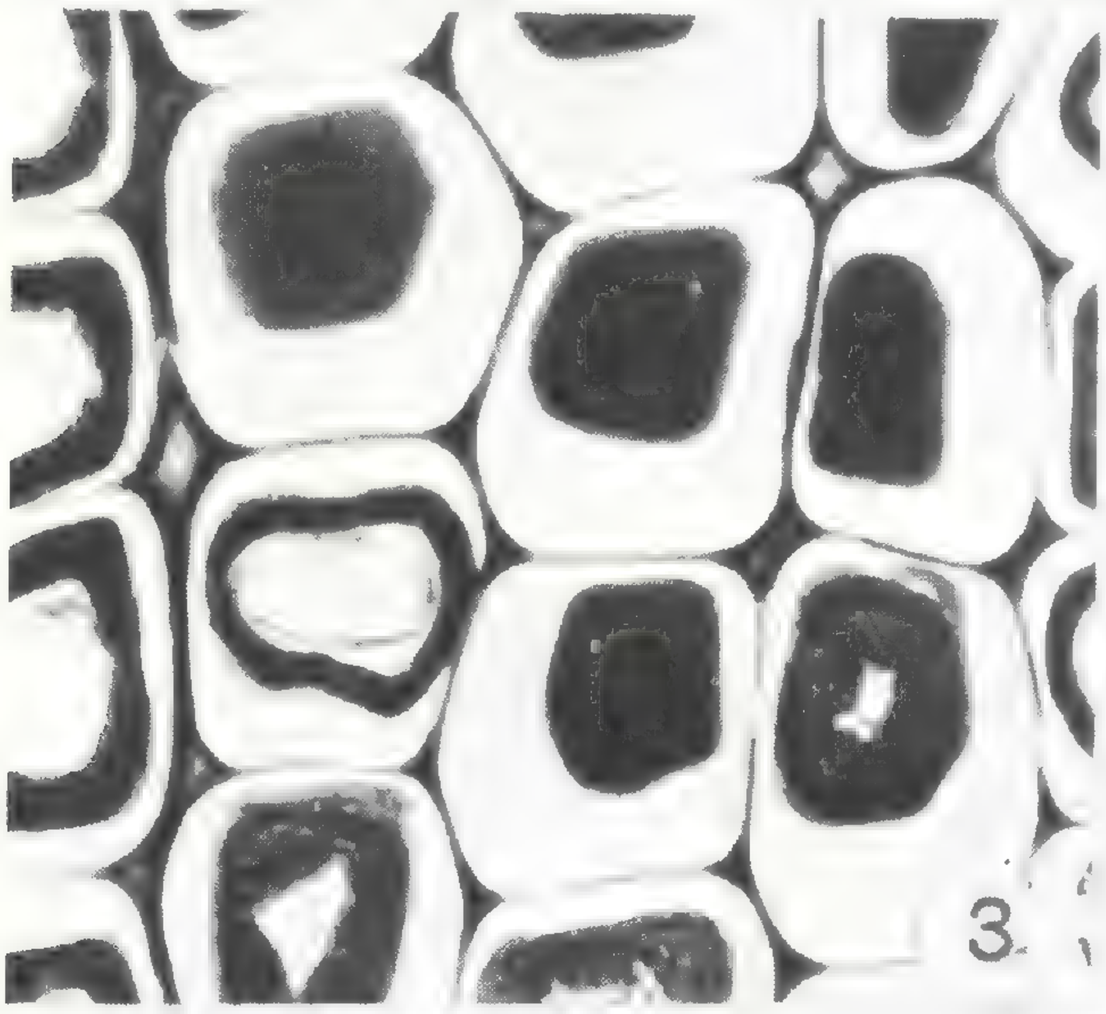
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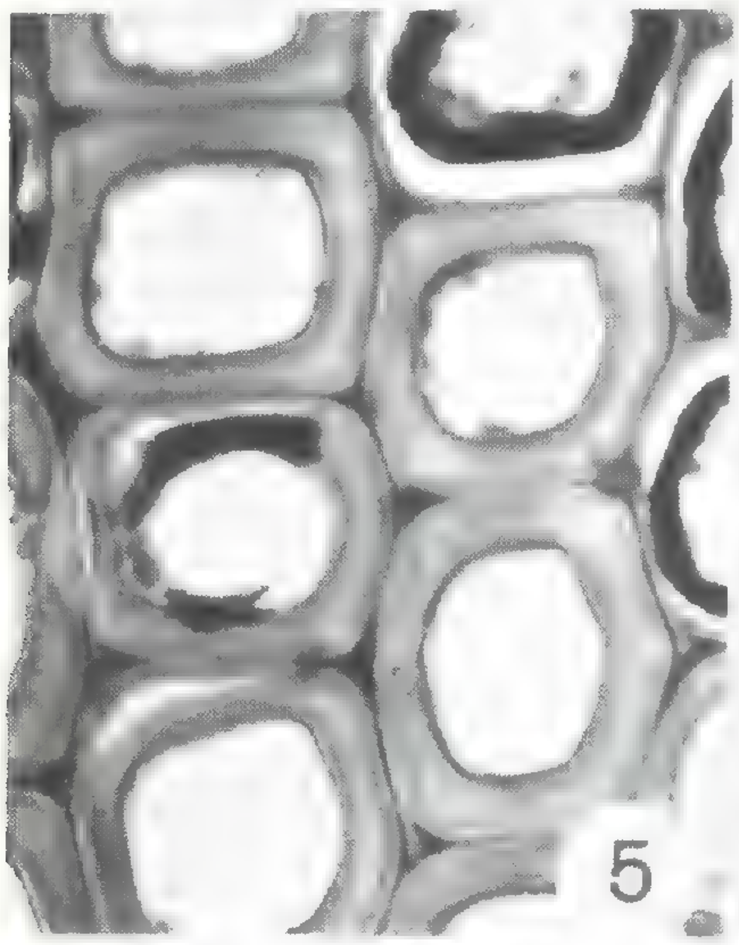
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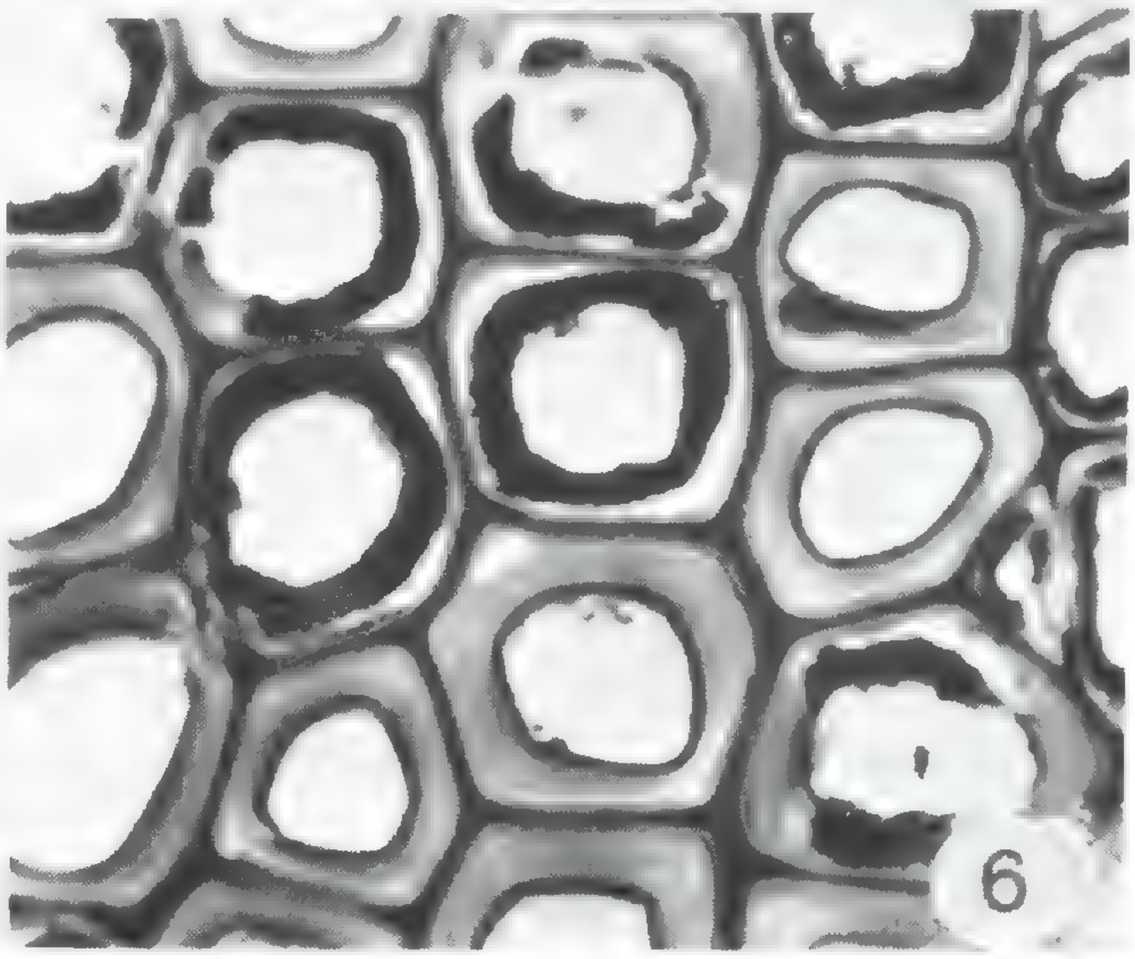
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EXPLANATION OF THE ILLUSTRATIONS

PLATE II. Sections of wood of submerged white pine stump.

FIG. 1. Transverse section. Note the incipient degradation of the inner lamellae of the secondary wall of the tracheids, which shows compression wood, or "rotholz" structure. The heavily stained layers between the degraded inner lamellae and the less heavily stained outer secondary wall are non-cellulosic layers of the secondary wall. ×500.

FIG. 2. Transverse section. The visibly intact layers of the cell wall consist of the intercellular substance, primary wall and the outer secondary wall. The lignin residues of the central and innermost layers of the secondary wall form a discrete cylinder in the lumen of each cell. In this section, as also in Fig. 3, the outermost secondary wall is unusually thick and appears to consist of more than one layer. Undelignified, stained with Ruthenium red. ×800.

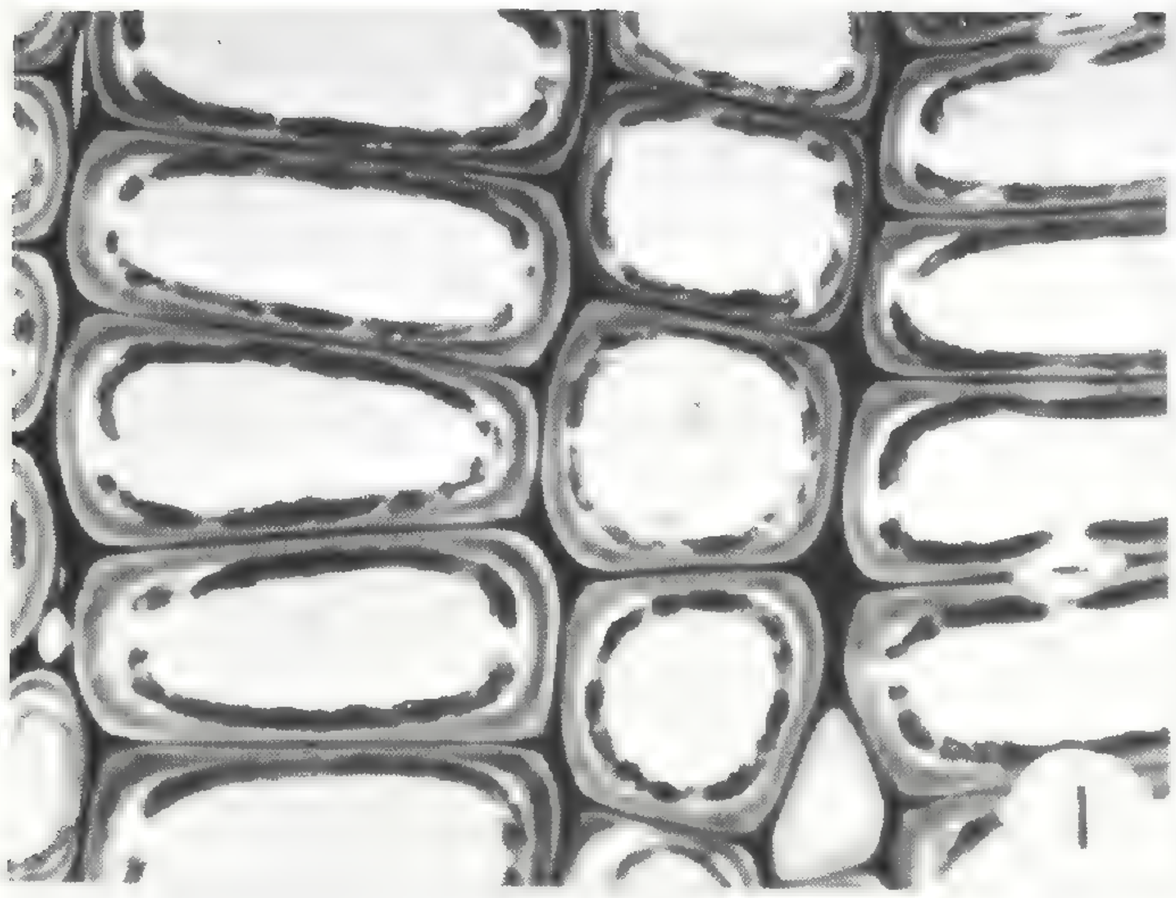
FIG. 3. Same section shown in Fig. 2, except more highly magnified. Undelignified, stained with Ruthenium red. 1400.

FIG. 4. Transverse section showing varying extent of degradation of the secondary wall lamellae. ×800.

FIG. 5. Transverse section of less degraded wood from inner parts of the stump. Note the varying degrees of degradation of the secondary wall and the retention of a structural framework of modified cell walls. Unstained preparation. ×220.

FIG. 6. Same specimen as shown in Fig. 5, but from more extensively degraded wood. Unstained preparation. ×530.

Plate II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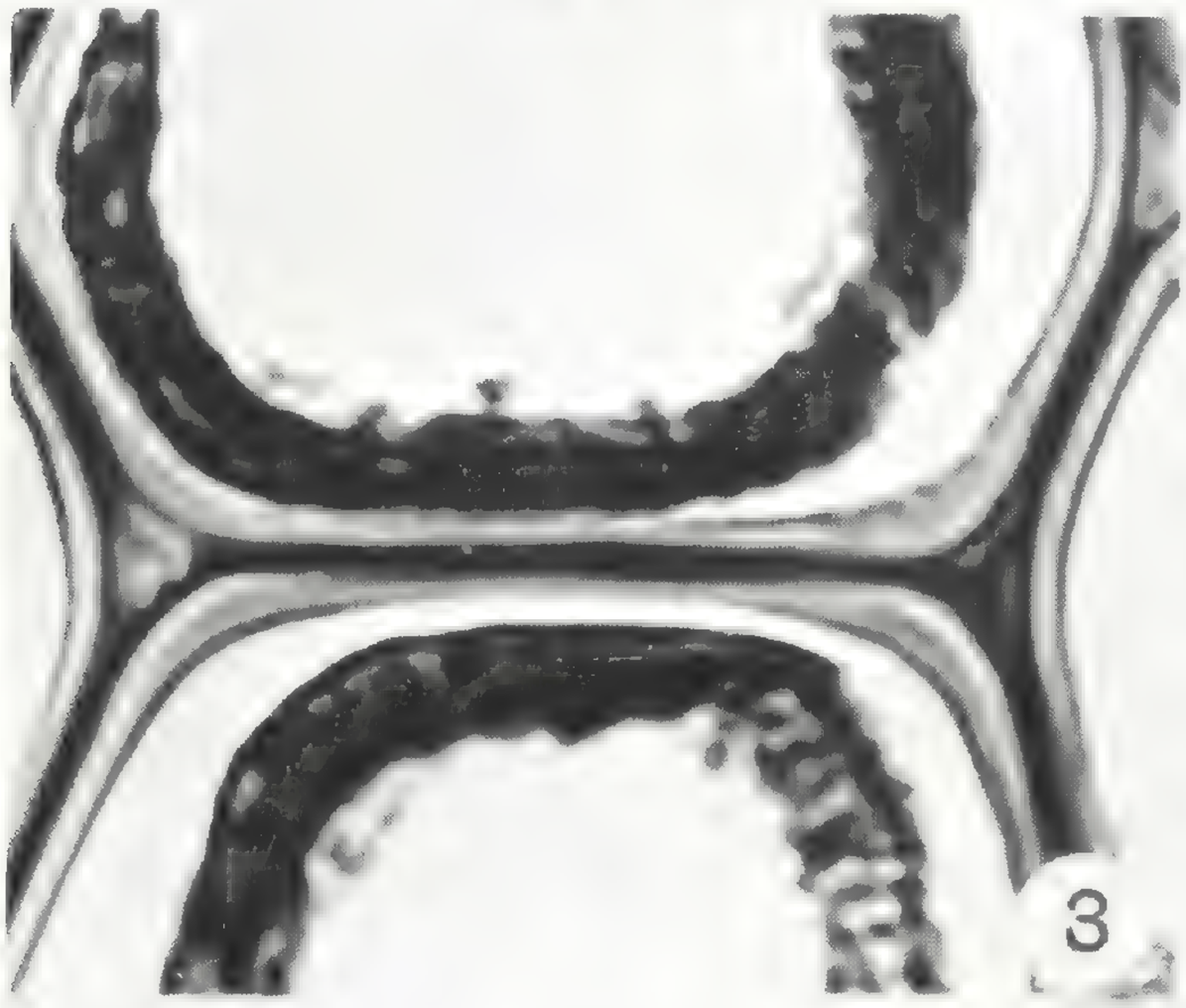
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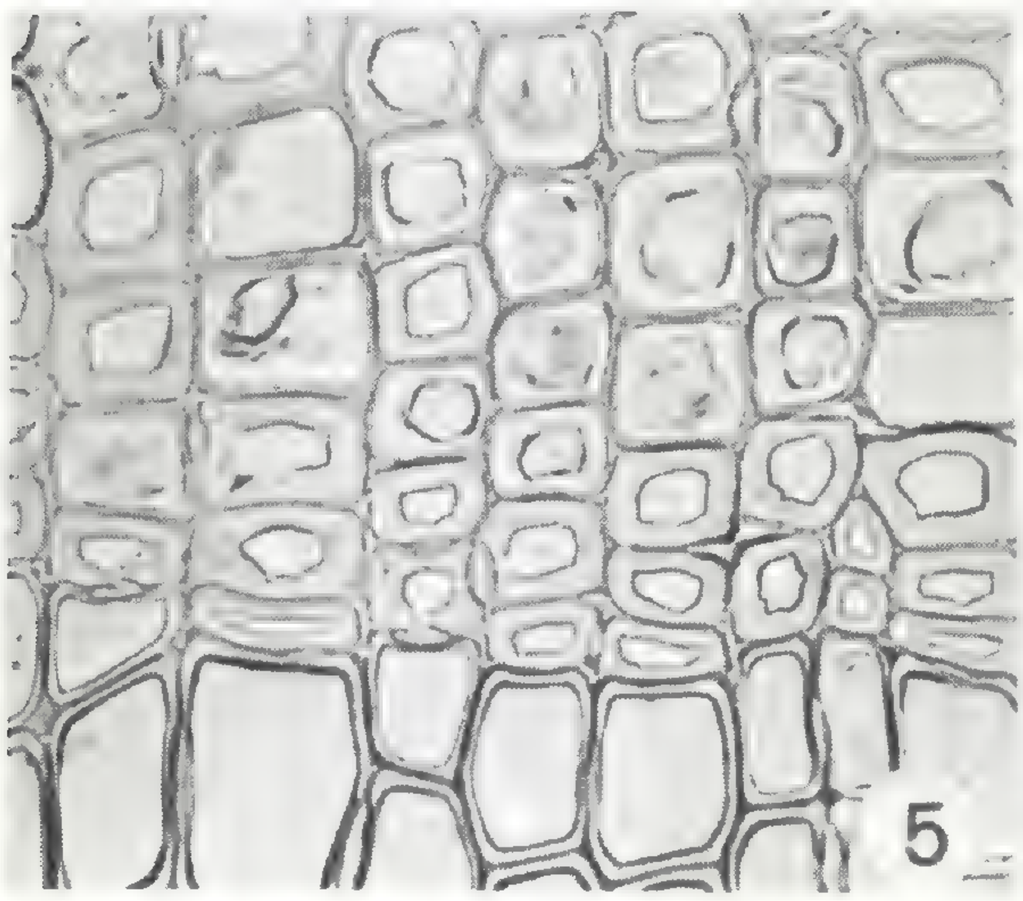
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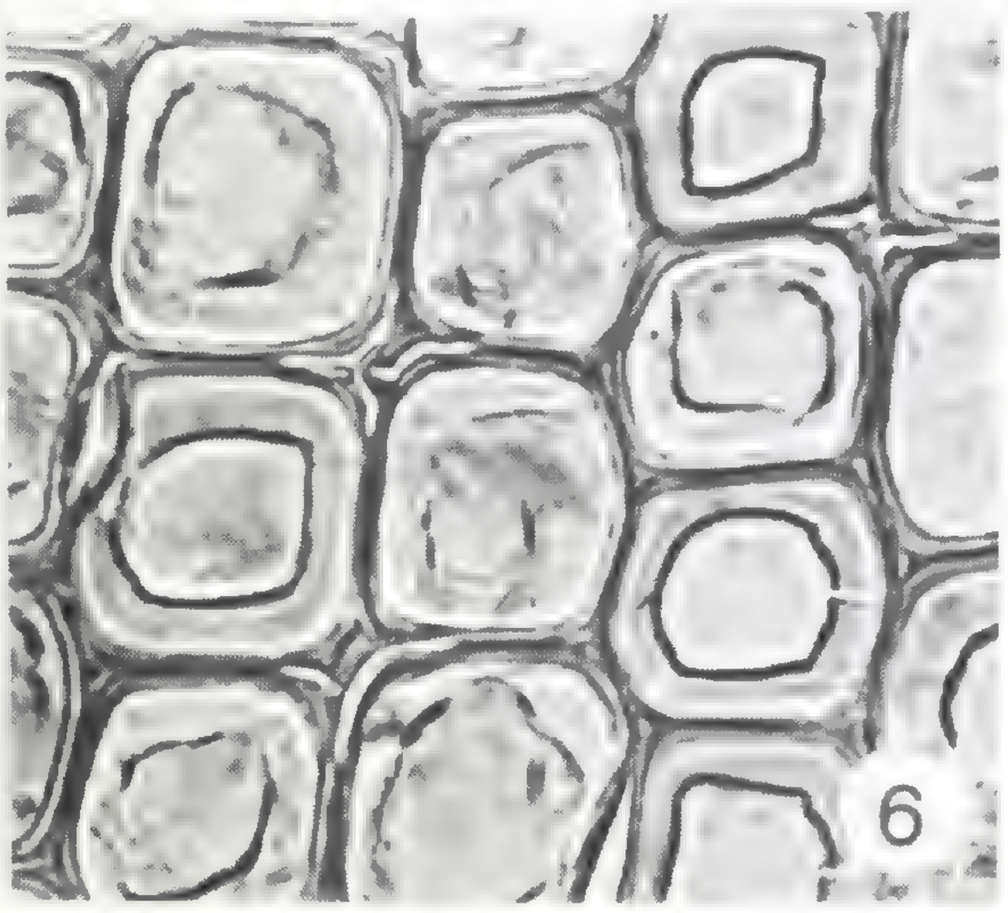
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EXPLANATION OF THE ILLUSTRATIONS

PLATE III. FIG. 1. Transverse section of wood of white pine stump. The section shows the cellulosic structural residue of degraded wood after extraction of lignin and lignin residues by sodium chlorite treatment. Four tracheids possess visibly intact secondary walls. All other cells are represented by walls consisting of intercellular substance, primary walls and *outermost* secondary walls. Stained with Ruthenium red. ×500.

FIG. 2. Same specimen as Fig. 1. The cellulosic structural residue consists of intercellular substance, primary walls and outermost secondary walls. Evidence for the presence of a secondary wall residue is provided by the persisting first formed layers of the pit borders. Delignified section stained with Ruthenium red. ×870.

FIG. 3. Same specimen as Fig. 1. Evidence that the cellulosic residue consists in large part of the outermost layer of secondary wall is shown by the conspicuous remnants of the borders of bordered pit-pairs. Note the retention of the pit torus. Delignified, stained with Ruthenium red. ×870.

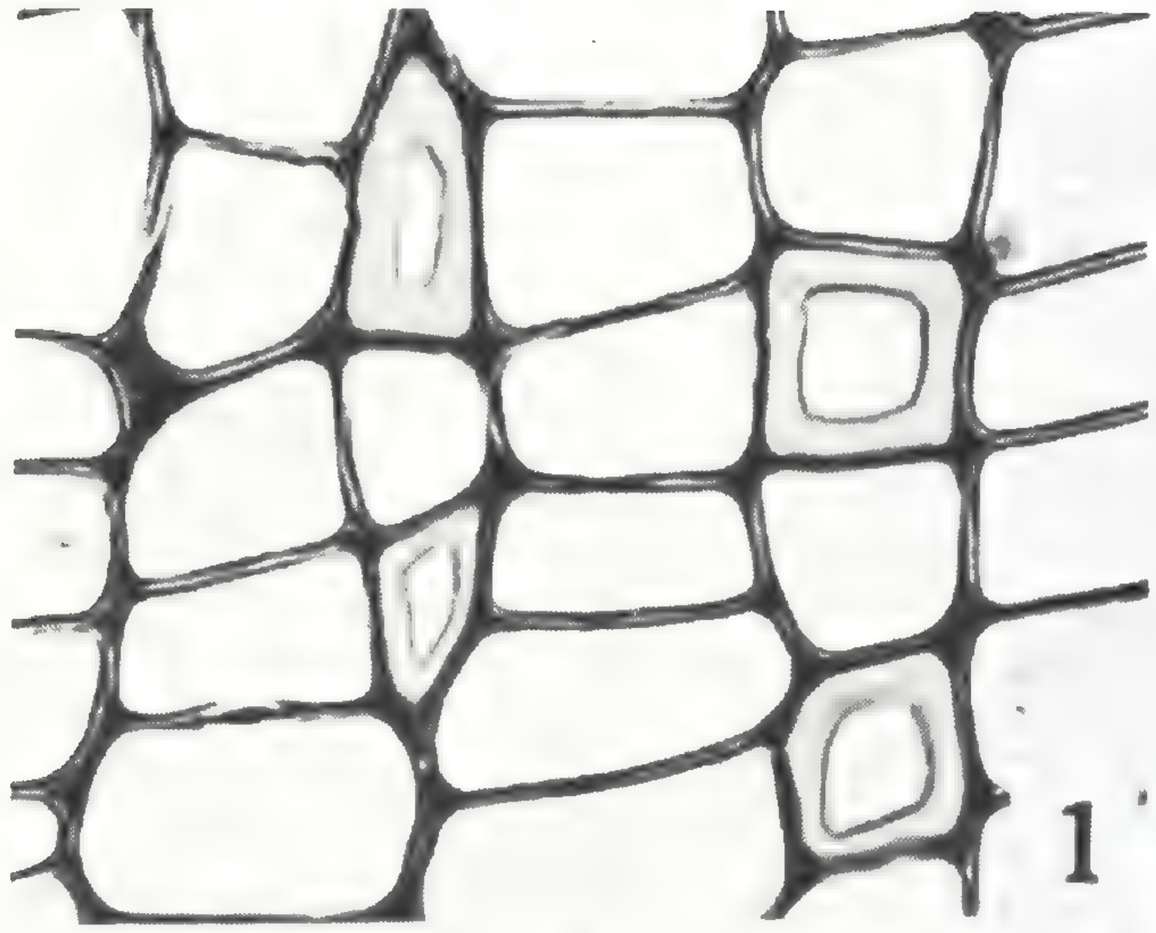
FIG. 4. Tangential longitudinal section of a degraded late wood tracheid of white pine showing the granular lignin residue of the secondary wall. Note the remnants of the bordered pit-pairs. Such cell wall residues, when delignified and viewed in transverse section, show the organization represented in Figs. 1, 2 and 3. × 500.

FIG. 5. Bordered pit-pairs of a normal spruce tracheid. Compare the lamellae with those shown in Figs. 2 and 3. ×870.

FIG. 6. Transverse section of "rotholz" of degraded white pine wood after treatment with 72 per cent sulphuric acid. The more heavily lignified primary walls and outer secondary walls yield a coherent structural residue comparable to that shown in Plate II, Figs. 2 and 3. × 800.

FIG. 7. Same specimen as shown in Fig. 6, but from different portion of the stump. Section treated with 72 per cent sulphuric acid. Note the lignin residue of the pit borders and compare with the cellulosic residue of the pit borders shown in Fig. 3. ×500.

Plate III



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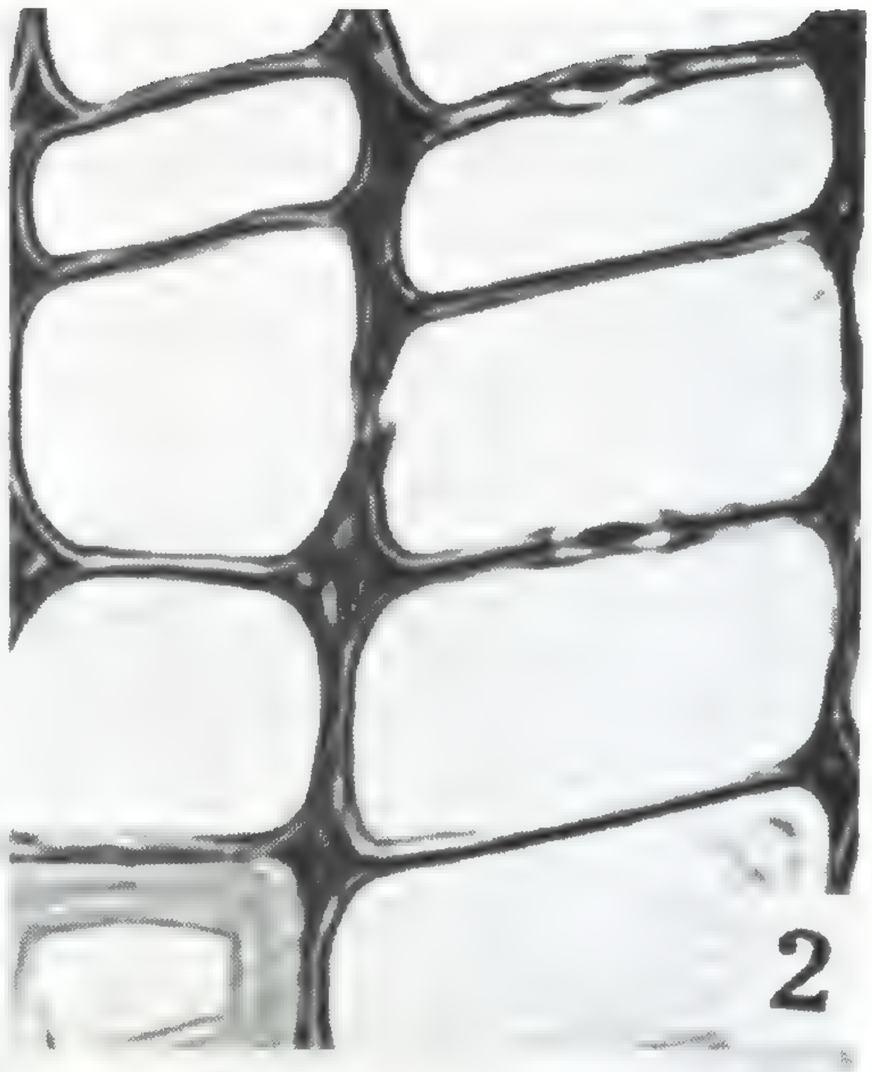

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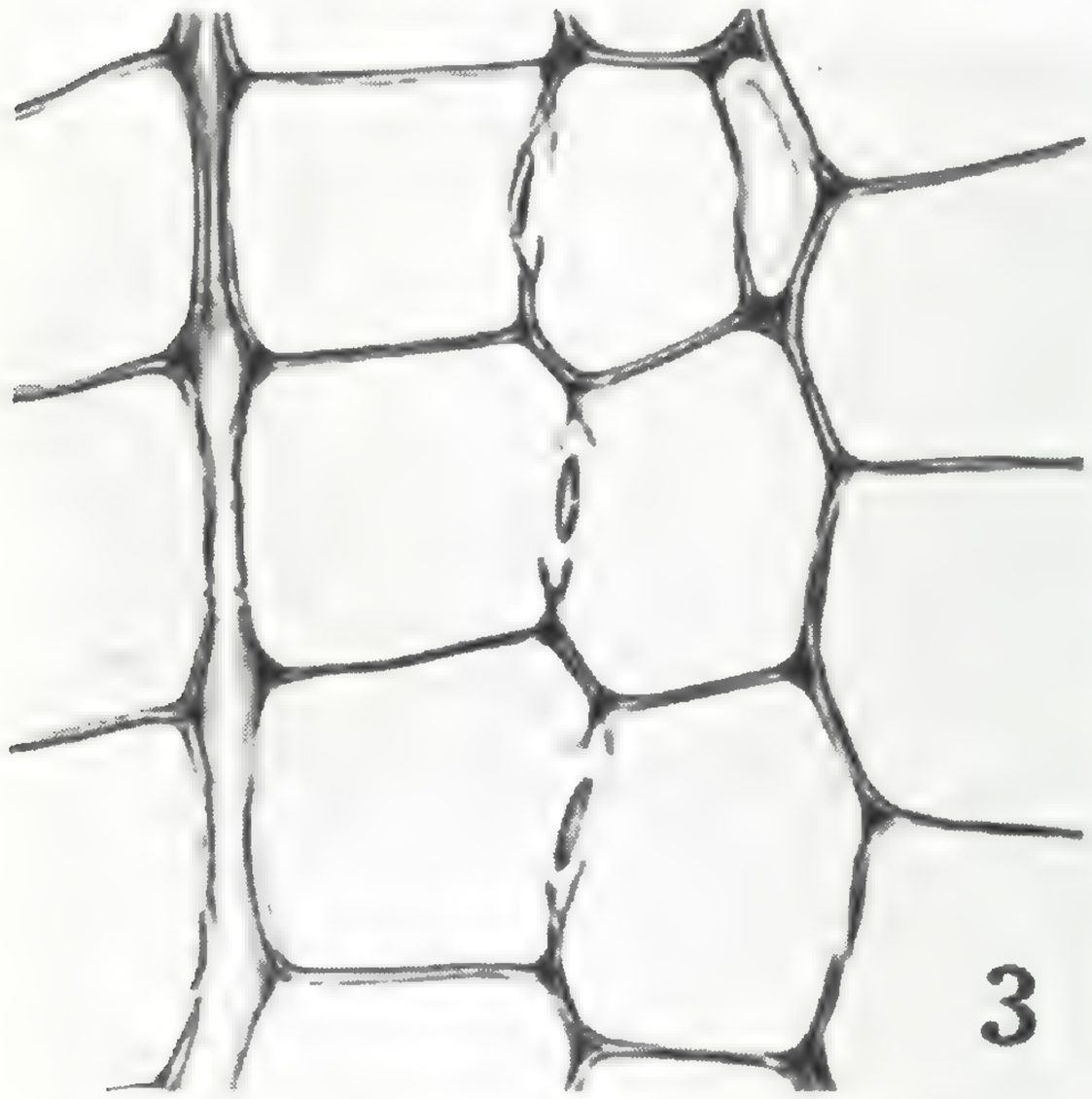

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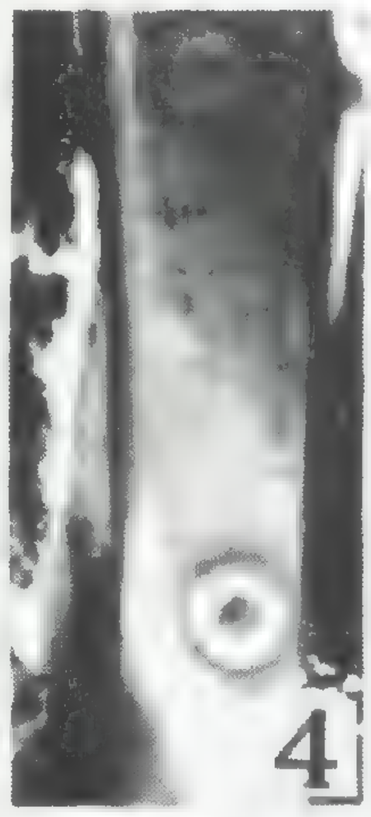

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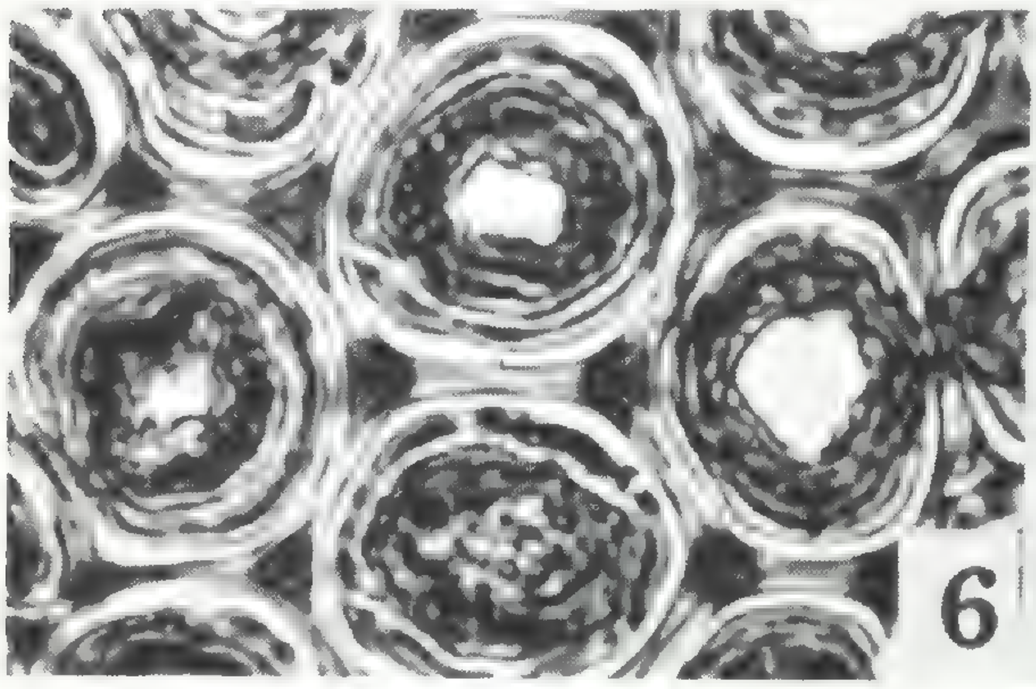

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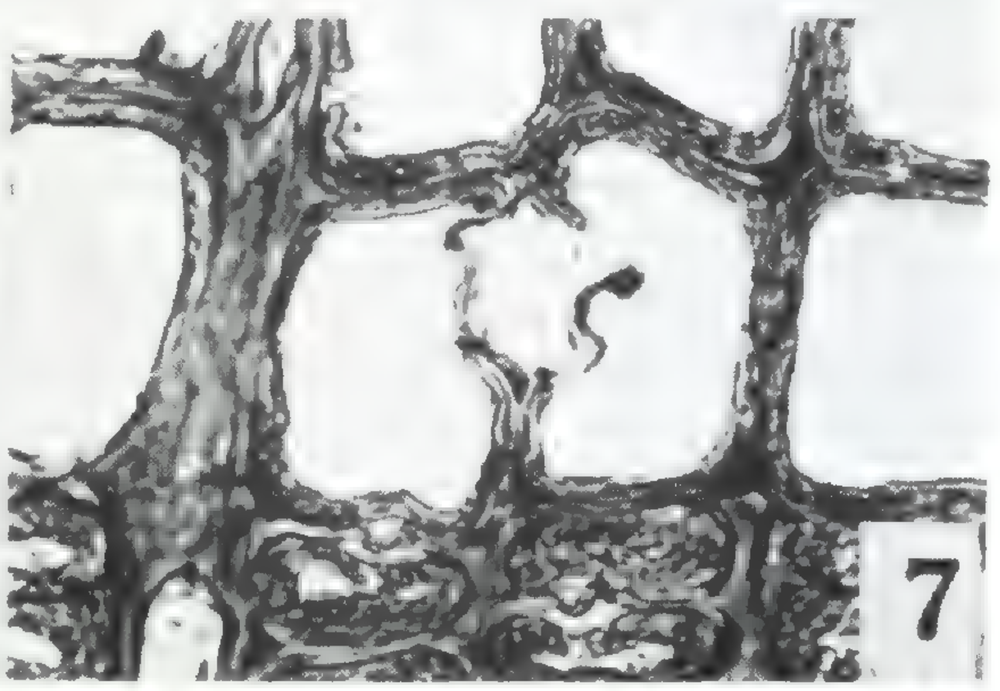

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EXPLANATION OF THE ILLUSTRATIONS

PLATE IV. FIG. 1. Transverse section of xylem of *Laurelia aromatica* Juss., showing enzymatically produced cavities in the secondary wall. Note the partial localization of action within the central layers. (After Bailey, I. W. and Mary Vestal: Journ. Arnold Arboretum 28, Plate 209: 1937.) ·990.

FIG. 2. Transverse section of hard pine wood which was exposed to the sea and to the action of marine fungi. Enzymatic attack on the cell wall is concentrated within the central layers. Compare with anaerobic degradation as shown in Plates I, II and III. ×500.

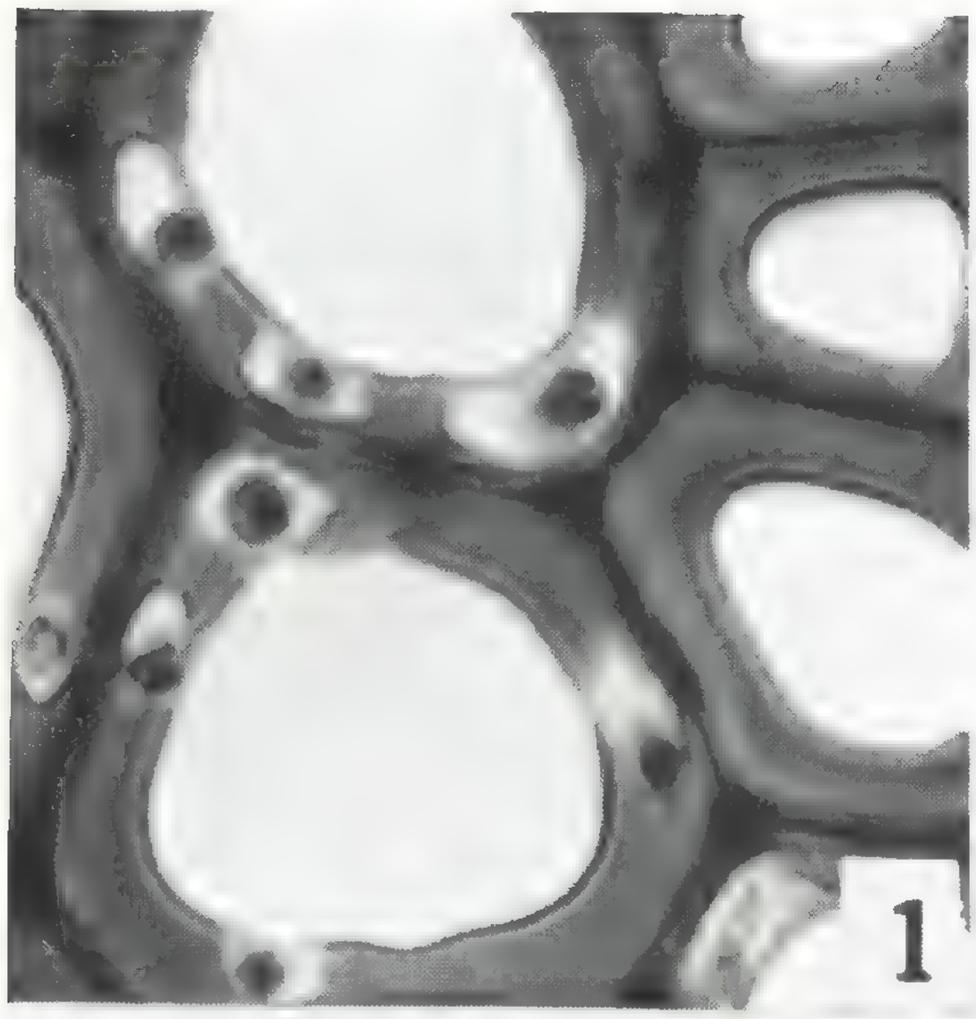
FIG. 3. Tangential section of xylem of *Ulmus crassifolia* Nutt. showing normal wood structure. ×100.

FIG. 4. Tangential section of xylem of *Ulmus americana* L. degraded by an unidentified brown rot fungus. The structural residue closely resembles delignified residues of anaerobically degraded wood as shown by comparison with Plate III, Figs. 1, 2 and 3. ×100.

FIG. 5. Transverse section of xylem of *Ulmus americana* L. showing normal wood, with scattered gelatinous fibers. 100.

FIG. 6. Transverse section of xylem of *Ulmus americana* L. degraded by unidentified brown rot. Same specimen as shown in Fig. 4. The structural residue is lignified cellulose as shown by lignin extraction. > 100.

Plate IV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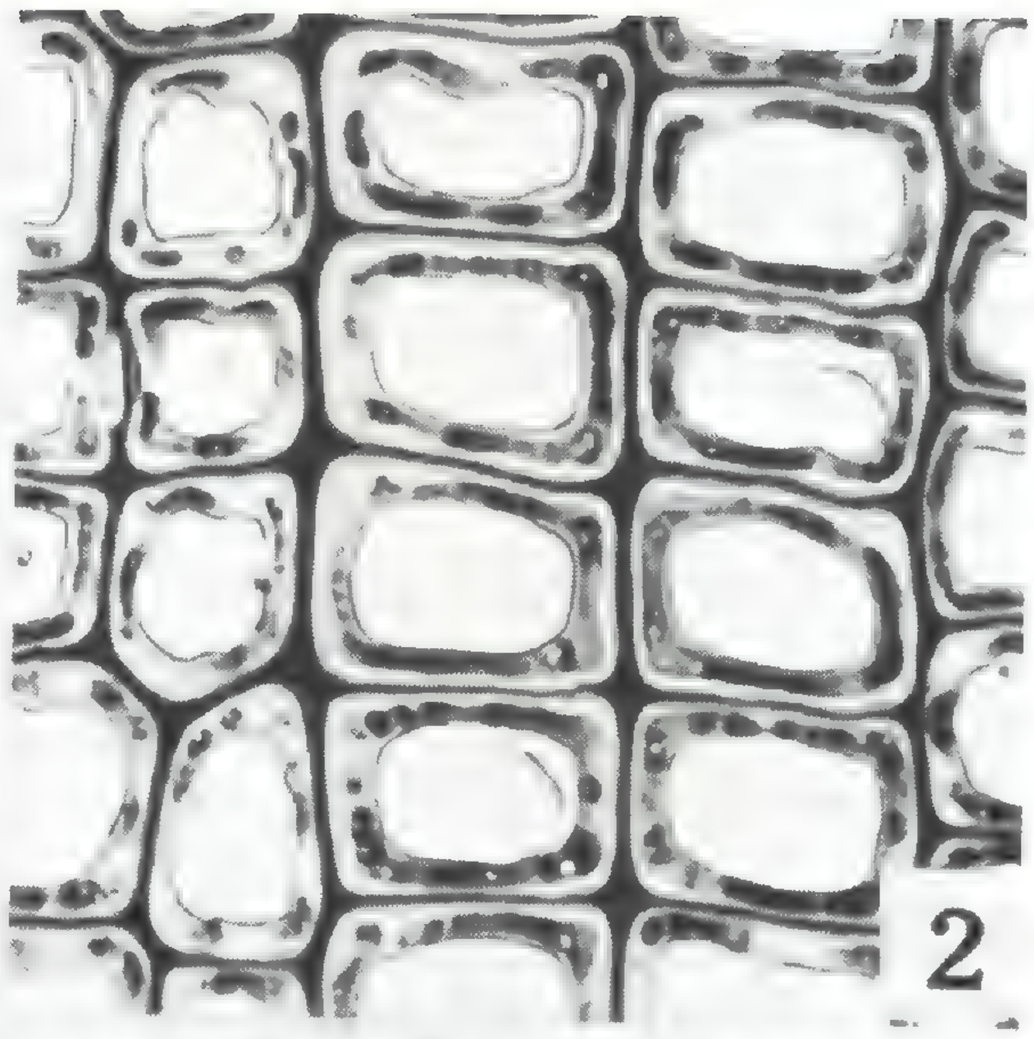
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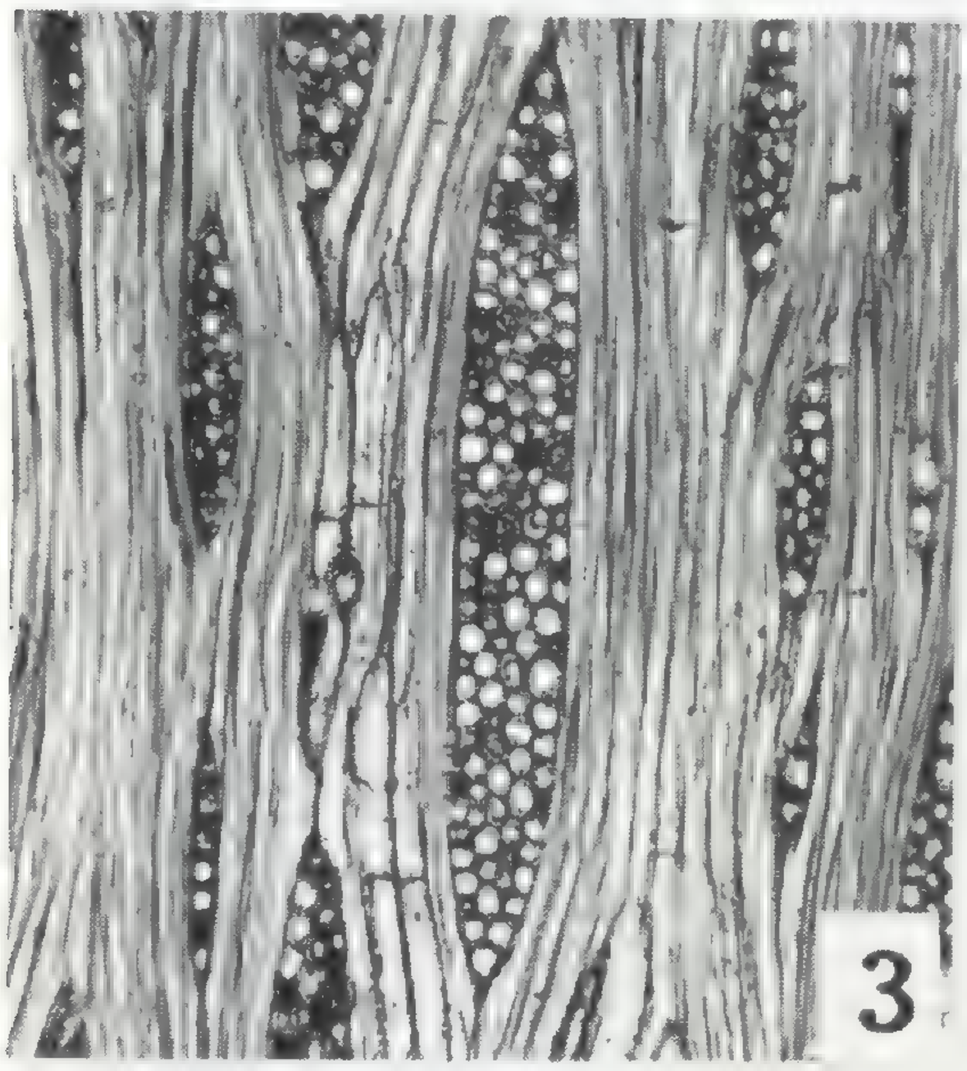
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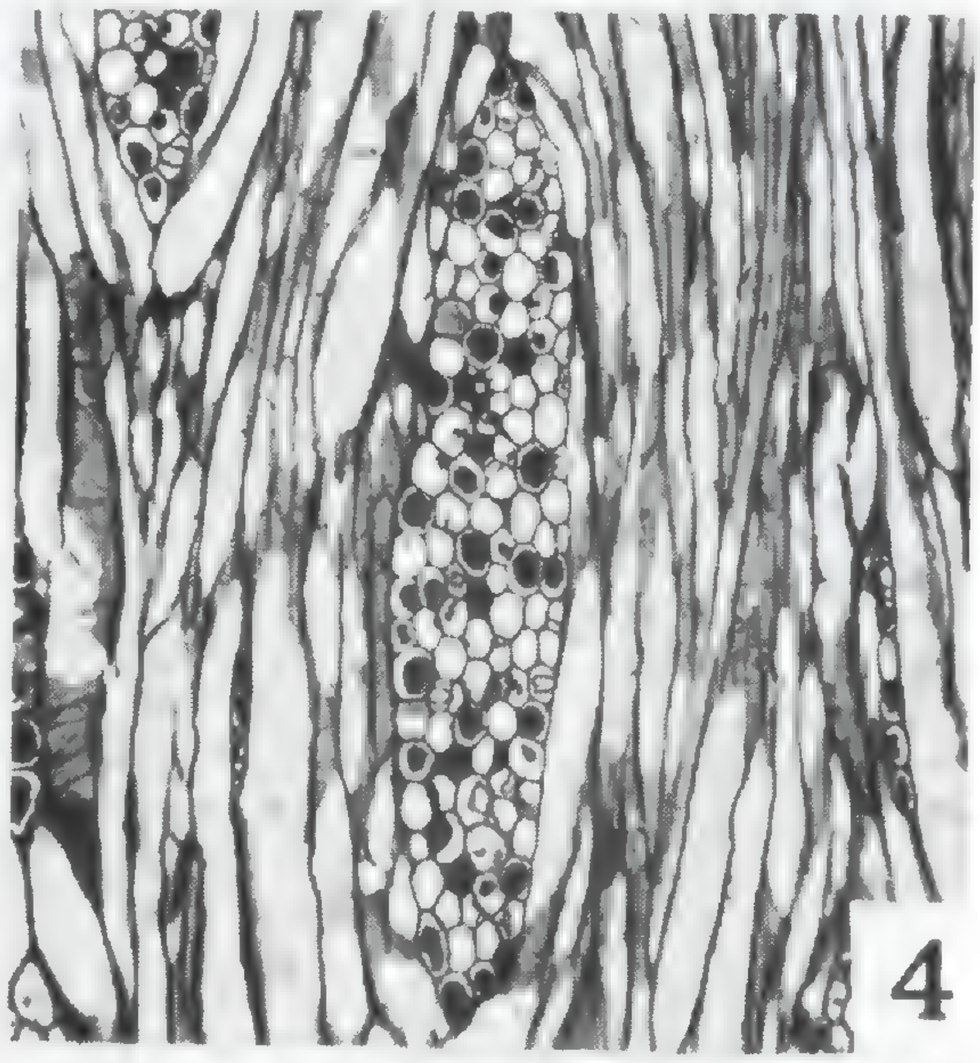
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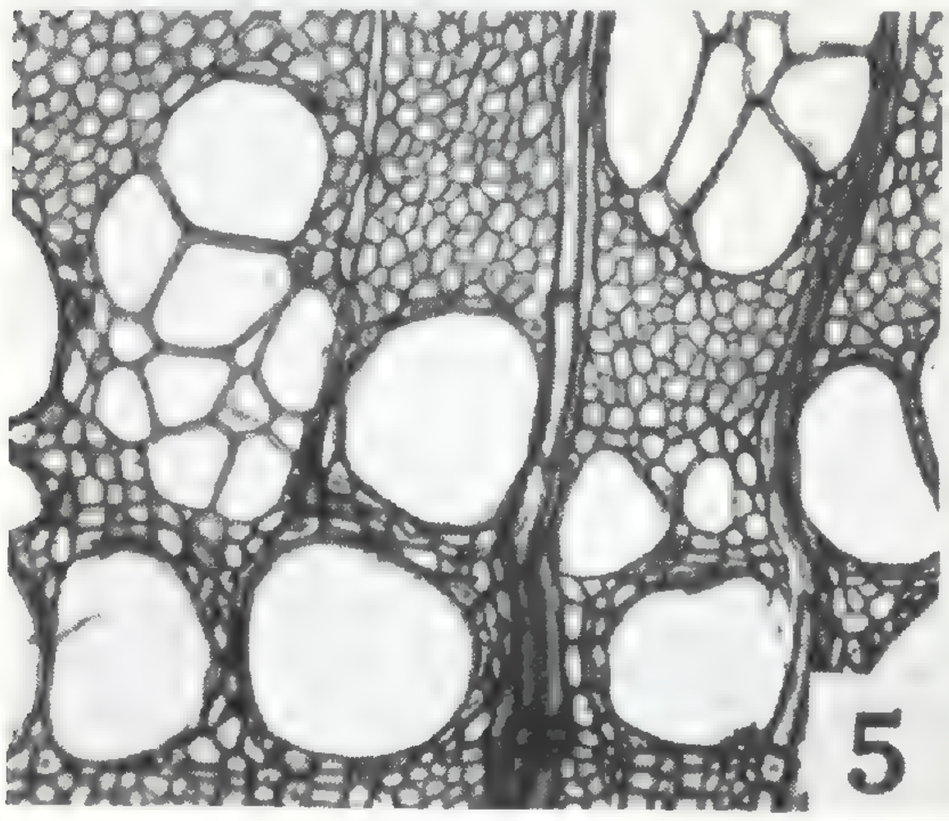
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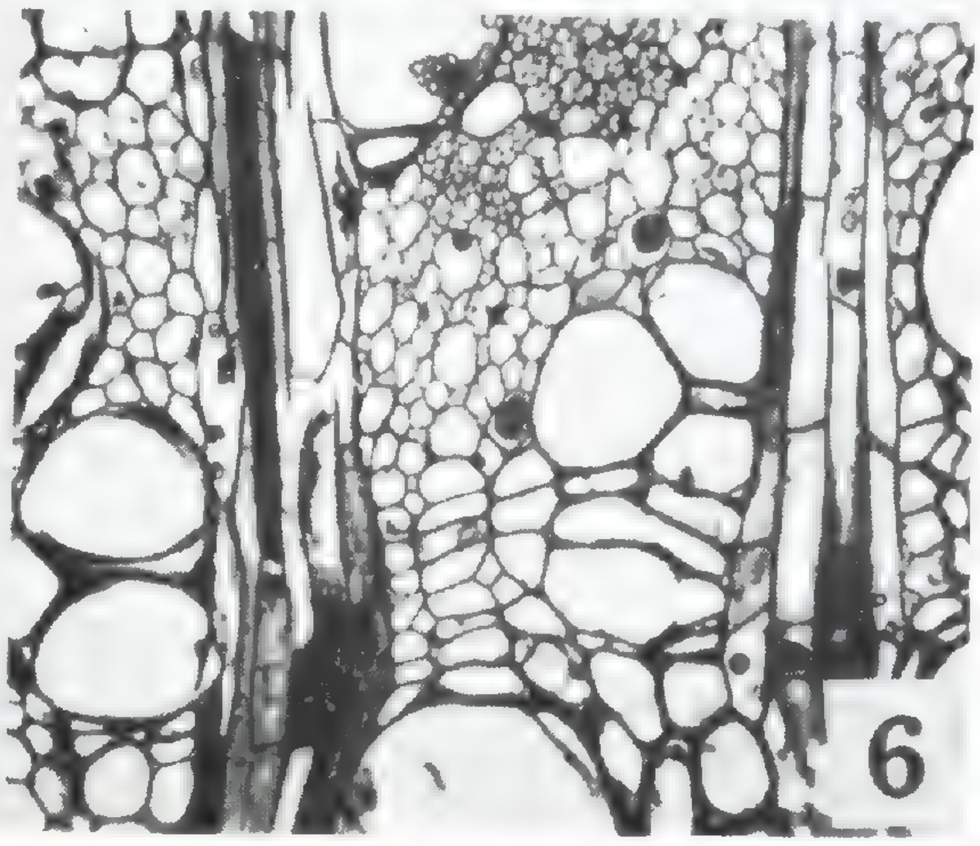
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EXPLANATION OF THE ILLUSTRATIONS

PLATE V. FIG. 1. Transverse section of an unidentified fossil wood of Cretaceous age. The wood is an intensely silicified organic residue of the original woody tissue. The cell wall layers retained closely resemble the cellulosic residues of anaerobically degraded wood as shown by comparison with Plates I and II. Ground section. ×132.

FIG. 2. Same specimen as shown in Fig. 1, but more highly magnified. Note the "lignin" residue of the secondary wall. ×732.

FIG. 3. *Robinia Pseudo-Acacia* L. Portion of vessel wall showing structure of the vestured pits. The vestured portion of the pit consists of primary wall. ×1532.

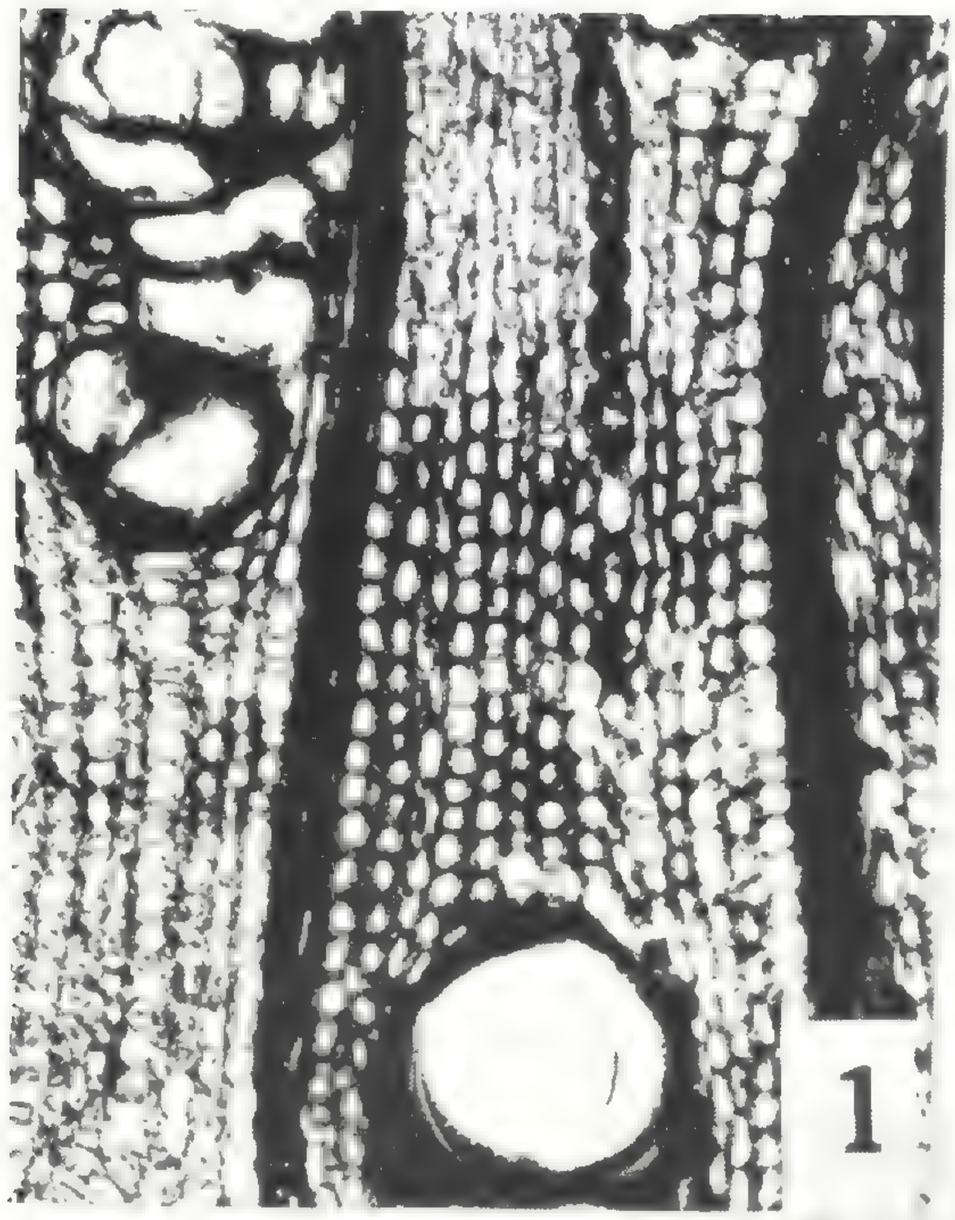
FIG. 4. *Robinia* sp. Silicified wood from the Tertiary of Montana. Portion of vessel wall showing retention of structure of the vestured pits. Compare with normal wood of *Robinia Pseudo-Acacia* L. shown in Fig. 3. Ground section. ×860.

FIG. 5. Same specimen as shown in Figs. 1 and 2, but with varying degrees of degradation of the cell wall previous to silification. Ground section. ×732.

FIG. 6. Tangential longitudinal section of same specimen as shown in Fig. 4. The beaded structure of the more resistant primary wall is preserved as an organic residue, consisting of modified lignin and embedded in silica. Ground section. ×225.

FIG. 7. Same as Fig. 6, except more highly magnified. Ground section. ×860.

PLATE V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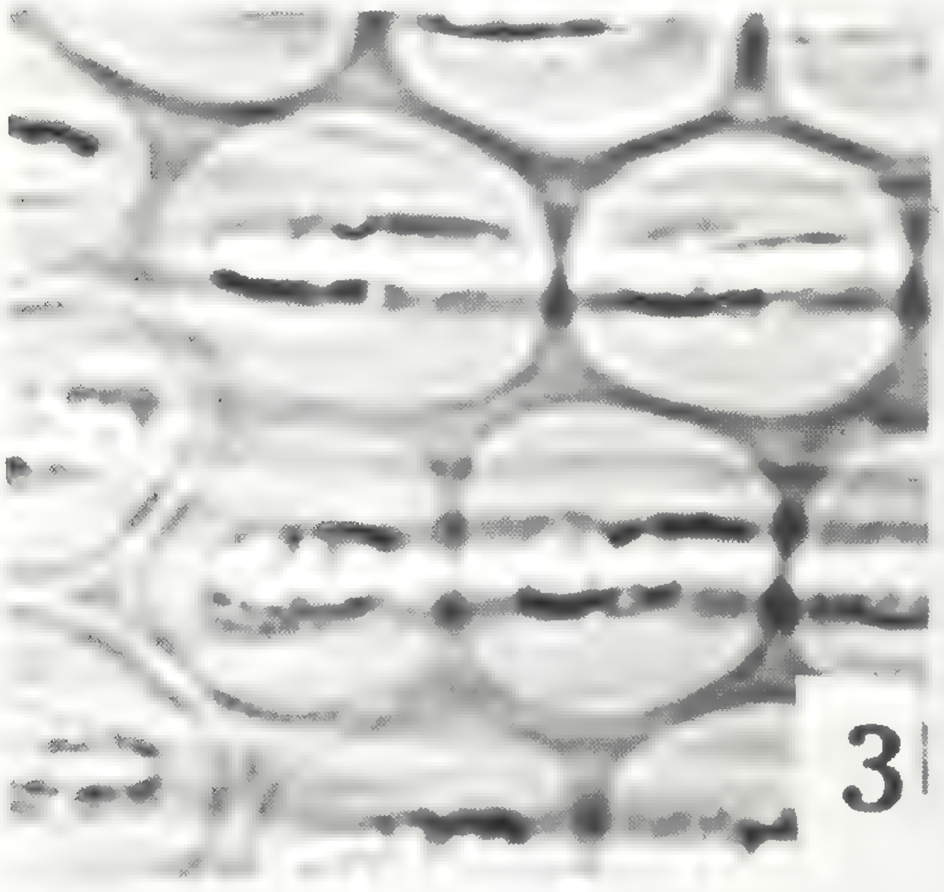
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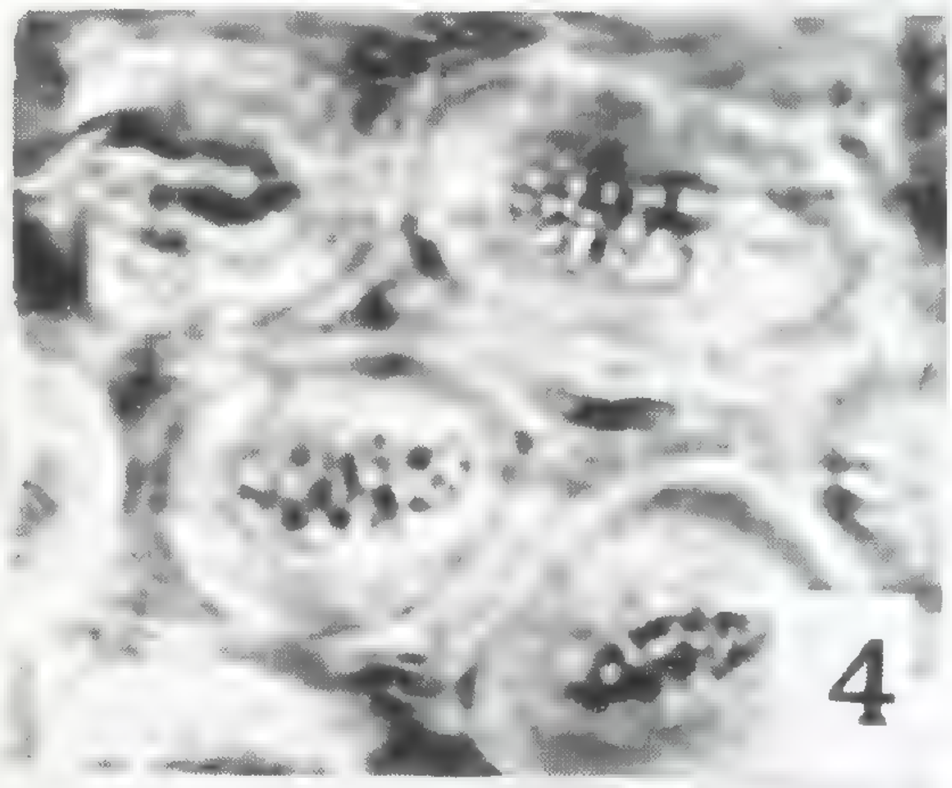
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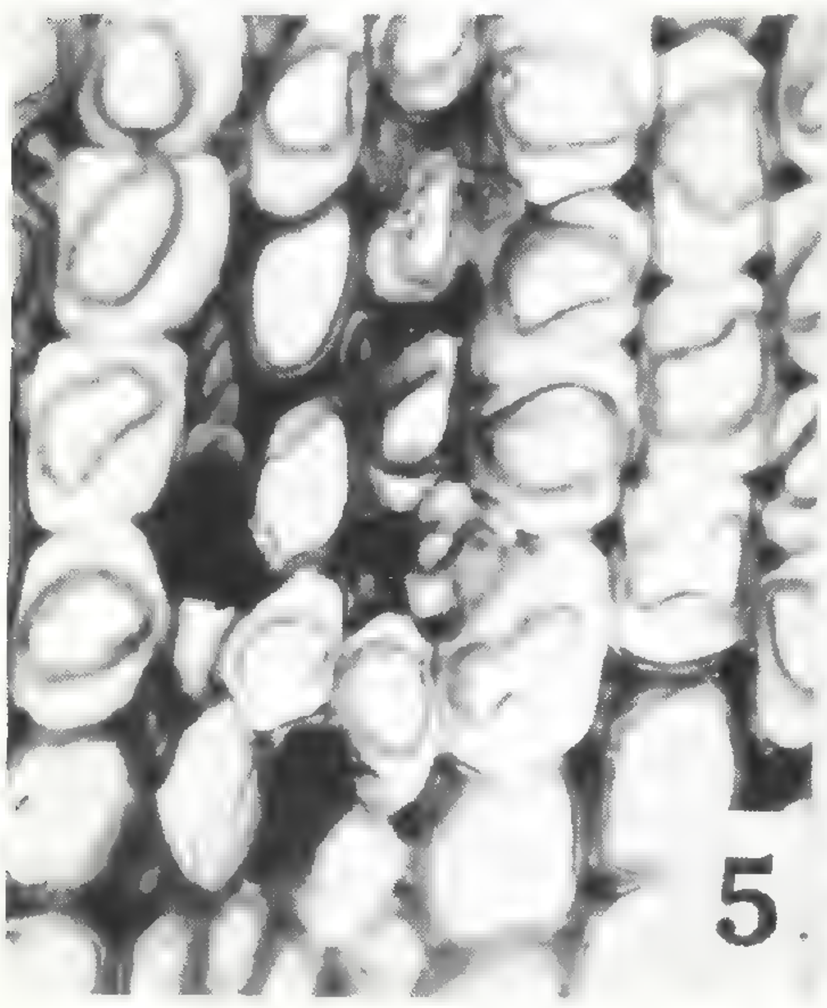
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6

7

EXPLANATION OF THE ILLUSTRATIONS

PLATE VI. FIG. 1. Portion of root of *Juncus* sp. isolated from postglacial peat. Age approximately 4000 to 5000 years. The heavily lignified fibrous and conductive tissue in the center of the root has been largely degraded, whereas the delicate unlignified epidermal structures are preserved. ×132.

FIG. 2. Root epidermis of *Scirpus* sp. from same peat. Note preservation of epidermal cells. ×126.

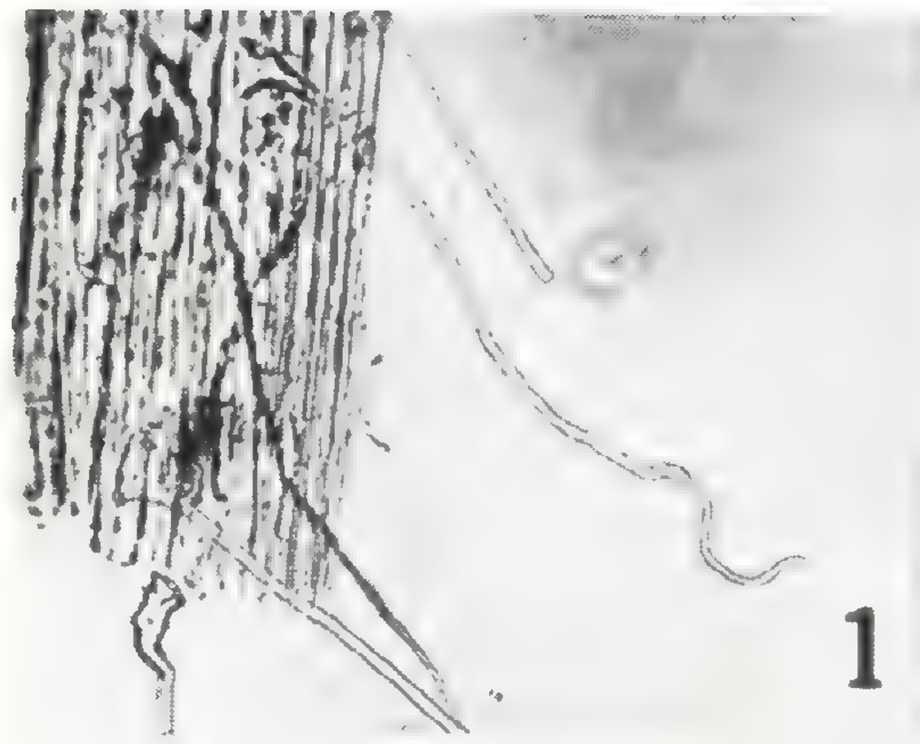
FIG. 3. Root epidermis of *Carex* sp. from same peat. ×126.

FIG. 4. Root tip of unidentified monocotyledonous root from same peat. Note preservation of minute structural details of root cap. Treated with acidified sodium chlorite. ×126.

FIG. 5. Cells of a root apex meristem from the same peat showing preservation of primary cell walls and the residue of cell contents. Thin section of peat, unstained. ×500.

FIG. 6. Root epidermis of *Carex* sp. showing preservation of unlignified primary walls of epidermal cells. ×126.

Plate VI



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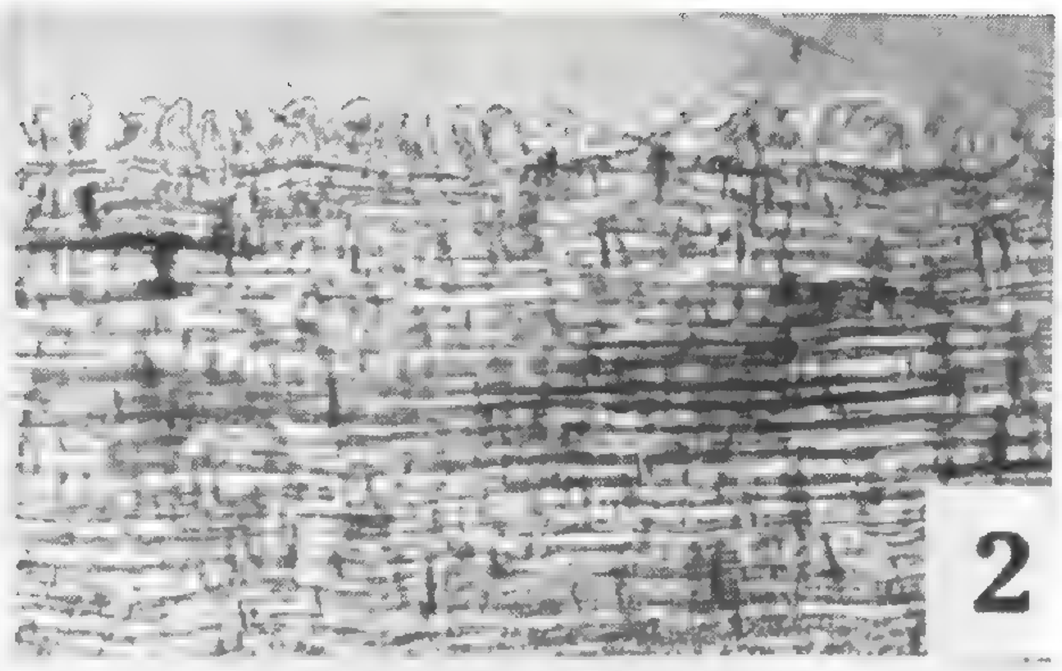

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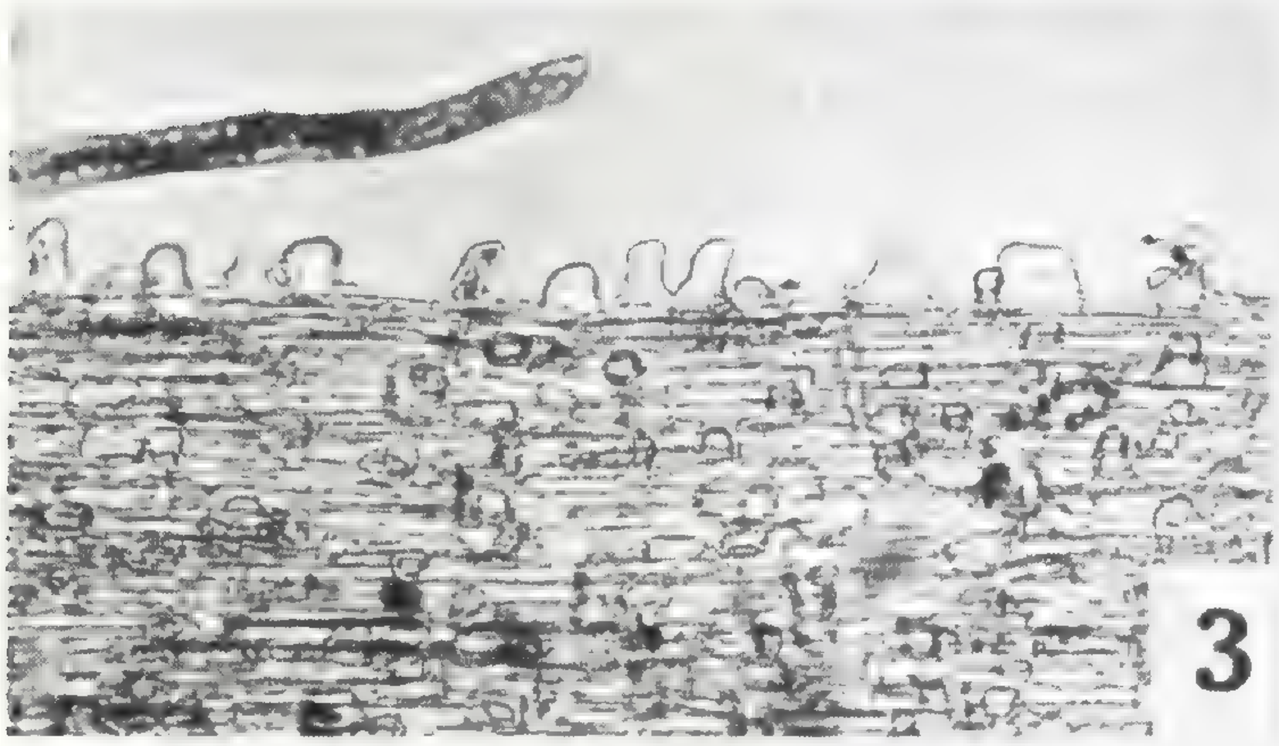

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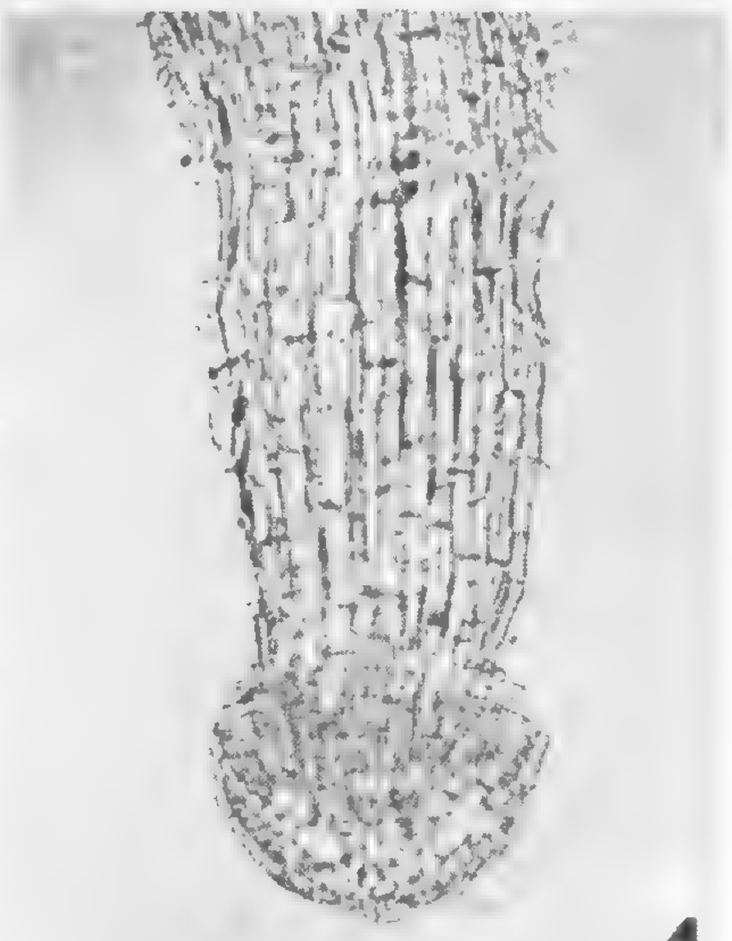

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BOTANICAL MUSEUM LEAFLETS
HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS, OCTOBER 26, 1949 VOL. 14, NO. 2

PLANTAE COLOMBIANAE XII
DE PLANTIS PRINCIPALITER AMAZONIAE COLOMBIANAE INVESTIGATIONES

BY

RICHARD EVANS SCHULTES[1]

THE Amazonia of Colombia, vast and, for the most part, still unknown, has a surprisingly varied flora. Botanical explorations of this northwesternmost part of the great Amazon Valley have been pitifully few in relation to the size of the area and the wealth of its flora. Colombia's Amazon region is divided into the Comisarías of the Putumayo, Caquetá, Amazonas and Vaupés. It comprises about 404,000 square kilometers or one-third the area of the entire country. It is at once obvious how vital to our understanding of the flora of the rest of Colombia, as well as of the whole Amazon basin, is a clear conception of the phytogeographical relationships of the vegetation of this immense area.

In the course of identifying recent collections from the Colombian Amazonia, I have found that a number of these represent hitherto apparently undescribed concepts or concepts previously unknown either from Colombia or from its Amazonian regions. It seems advisable to publish, from time to time, collected notes of this type

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as a contribution towards our understanding of the flora of Colombia.

I wish to thank the following botanists for their collaboration: Dr. José Cuatrecasas of the Chicago Museum, who has studied the representatives of *Cecropia* and *Quararibea;* Dr. Robert E. Woodson of the Missouri Botanical Garden, who identified the apocynaceous species; Padre Lorenzo Uribe of Medellín and Bogotá, Colombia, who determined the specimens of *Inga;* Dr. B. A. Krukoff and Mr. Joseph Monachino who have attended to the collections of *Strychnos;* and Dr. F. A. Stafleu of Proefstation voor de Java Suikerindustrie, Pasoerocan, Java, who identified the representatives of *Vochysia.* I have also to thank Dr. Frederick J. Hermann of the United States Department of Agriculture for placing at my disposal the notes and identified plant specimens which he collected, some for the first time in Colombian territory, in the Leticia area in 1944.

Cyperaceae

Fimbristylis miliacea (*L.*) *Vahl* Enum. 2 (1805) 287.

Collections of *Fimbristylis miliacea* have been made in British and Dutch Guiana, Venezuela and Ecuador. *Hermann 11318* represents apparently the first collection to be reported from Amazonian Colombia.

Colombia: Intendencia del Amazonas, Leticia, April, 1944, *Frederick J. Hermann 11318.*

Araceae

Pistia Stratiotes *Linnaeus* Sp. Pl. (1753) 963.

This very widespread tropical American plant is known from almost all parts of Middle and South America. Although collections have been made from nearly every other district of Colombia, *Hermann 11301* would seem

to be the first reported from the Amazon watershed of the Republic.

COLOMBIA: Intendencia del Amazonas, Río Loretoyacu, floating on the river near its mouth, April, 1944, *Frederick J. Hermann 11301*.

LEMNACEAE

Lemna valdiviana *Philippi* in Linnaea 33 (1864) 239.

The collections cited below seem to be the first of this minute floating plant from the Amazon watershed of Colombia and adjacent Peru.

COLOMBIA: Intendencia del Amazonas, Río Hamacayacu, April, 1944, *Frederick J. Hermann 11312*.

PERU: Departamento de Loreto, Río Amazonas, Isla Cacao, April, 1944, *Frederick J. Hermann 11313*.

Spirodela polyrrhiza (*L.*) *Schleiden* in Linnaea 13 (1839) 392.

This interesting little aquatic plant has apparently never before been collected in the Colombian Amazon watershed. It has been known from Boyacá and Santa Marta in Colombia and from Guayas Province in Ecuador and Loreto in Peru.

COLOMBIA: Intendencia del Amazonas, Leticia, April, 1944, *Frederick J. Hermann 11315*.

VELLOZIACEAE

Vellozia phantasmagoria *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 12 (1946) 130, pl. 19, 20.

A specimen of *Cuatrecasas 7700* has recently come to my attention during studies in the United States National Herbarium. It would appear to represent *Vellozia phantasmagoria*, a dominant shrub on Mount Chiribiquete which is located slightly southeast of San José del Guaviare and which has a number of floral elements in common with the granitic hill at San José. The sterile

condition of the specimen, however, precludes definite identification. Nevertheless, it represents the northwesternmost collection of the *Velloziaceae* from the Amazon Valley and from South America.

COLOMBIA: Intendencia del Meta, Río Guaviare, San José del Guaviare, terrenos graníticos, sabana, alt. 270 m. "Ramificada, 1–2 m. alt." December 11, 1939, *J. Cuatrecasas 7700.*

MORACEAE

Cecropia mocoana *Cuatrecasas sp. nov.*

Arbor parva. Ramuli scabri, pilis conicis rigidis inclinatis et pilis longioribus hamatis praediti. Folia ampla, membranacea, peltata, longe petiolata. Petiolus robustus, 50 cm. longus, striatus, copiose hirsutus cum pilis longis saepe hamatis. Lamina palmata, profunde (3/4–4/5) 8-lobata; lobis majoribus obovato-oblongis, minoribus obovato-subrotundatis, omnibus abrupte acuminatis, basi contractis, margine integra vel leviter irregulariterque sinuata, lobo maximo ab insertione petioli usque ad apicem 54 cm. longo et 30 cm. lato, lobo minimo 24 cm. longo, 15 cm. lato, parte concrescenti 10–19 cm; supra viridis, strigosa, pilis conicis brevibus et pilis longis acutissimis inclinatis munita, nervis principalibus et secundariis notata; subtus albida, nervis primariis crasso-eminentibus valde hirsutis, secundariis angulo obtuso 1–3.5 cm. distantibus prominentibus hirsutulis, tertiis roseis transversalibus et reticulatis demum hirsutulis, inter hos lamina dense albo-arachnoideo-tomentosa. Inflorescentiae masculae geminatae. Pedunculus rigidus, mediocris, 6.5–7 cm. longus, strigosus, pilis hamatis acutis satis armatus. Spatha ovoideo-oblonga, acutiuscula, circa 13 cm. longa, extus villoso-hirsuta, intus puberula. Amenta masculina circa 28 fasciculata, graciliter pedicellata, praefloratione 7–10 cm. longa, postea usque ad 17 cm. longa, 3 mm. lata. Perigonium tubulosum, 2

mm. longum, glabrum vel apice setis parcissimis minutis donatum. Pedicelli subcapillares, 12–20 mm. longi, dense scabro-hirsutuli, pilis hamatis instructi.

Dr. Cuatrecasas writes: "*Cecropia mocoana* is closely related to *C. marginalis* Cuatr. and *C. discolor* Cuatr. From both, it differs in having leaves which are a little thinner and more abundantly pubescent on the upper surface and in having more conspicuous scales (small conic hairs) which cause the leaves to be rough. The leaves on the under surface are more like those of *C. marginalis* because of the nerves and venation which are more or less hirtose and not covered with arachnoideous tomentum; in *C. discolor* the arachnoideous tomentum is brightly white and covers the network. The spathes of *Cecropia mocoana* are densely villous-hirsute as in *C. discolor* (in this species they are glabrous or only puberulent inside, contrary to the statement in the original description), whereas in *C. marginalis* they are covered with a very short and obsolete tomentum. Only further abundant collections can indicate whether *Cecropia mocoana* represents a male specimen of one of these earlier species."

COLOMBIA: Comisaría del Putumayo, Mocoa, alrededores al norte, 750–850 m. "Small tree." December 3–7, 1942, *Richard Evans Schultes & C. Earle Smith 2003* (TYPE in Chicago Museum).

Cecropia porvenirensis *Cuatrecasas sp. nov.*

Arbor magna. Ramuli scabri, pilis conicis et longioribus hamatis satis instructi. Folia membranacea vel subcoriacea, peltata. Petiolus 32 cm. longus, juvenilis alboarachnoideus, deinde hirtus, pilis longis tenuibus rigidis patentibus inferne hamatis tantum ramanentibus. Lamina palmata profunde (2/3) 7-vel 6-lobata, lobis obovatis vel obovato-oblongis, basi constrictis, apice abrupte acuminatis, margine integra vel leviter irregulariterque

sinuata, lobo maximo ab insertione petioli usque ad apicem 35 cm. longo, 15 cm. lato, lobo minimo 14 cm. longo, 8 cm. lato, parte centrali concrescenti 7–13 cm.; supra viridis, scabra, pilis conicis minutis satis atque tuberculis acutis et pilis sparsis longis praedita, nervis primariis secundariisque valde conspicuis; subtus alba, nervis principalibus in foliis juvenilibus tomento arachnoideo deciduo deinde sparse hirtis, nervis secundariis prominentibus, adscendentibus, 1–2 cm. distantibus, plusminusve arachnoideis et sparsissime hirtulis vel glabrescentibus, reticulo venularum obsoleto et lamina reliqua tomento arachnoideo albo dense tecta. Stipula in statu juvenili 8 cm. longa, acuta, villoso-hirta, margine utrinque glabra, intus villoso-sericea. Inflorescentiae femineae geminatae. Pedunculus 6–8 cm. longus (fructifer usque ad 17 cm. longus) scabrido-hirtulus, tuberculis minutis atque pilis rigidis fragilibus patentibus rectis et hamatis munitus. Spatha cylindrica, apice longe angustata, acuta, 16 cm. longa, extus sparse puberula et arachnoidea, leviter scabrida, intus pubescenti-arachnoidea. Amenta feminea vulgo 5 vel 6 (4–7), leviter pedicellata, 11 cm. longa, 4 mm. lata, fructifera in sicco usque ad 23 cm. longa, 7–8 mm. crassa. Perigonium minute tuberculatum. Achaena elliptica, 2 mm. longa, 1 mm. lata, laevia. Pedicelli crassi, 3–4 mm. longi, scabri, pilis conicis brevibus et pilis longioribus hamatis instructi.

Concerning the relationship of this new species, Cuatrecasas writes: "*Cecropia porvenirensis* is closely related to *C. marginalis* Cuatr., but it differs by having the upper surface of the leaves very scabridous, the under surface more densely white-arachnoideous with the nerves much less hispid, and the lower part of the petiole with hooked hairs; the amenta are pedicellate, longer and usually five or six, while in *C. marginalis* they appear in groups of four and are sessile. The stipule of *Cecropia porvenirен-*

sis is villose inside, whereas in *C. marginalis* it is glabrous."

COLOMBIA: Comisaría del Putumayo, Puerto Porvenir cerca de Puerto Ospina, alt. 250 m. "Large tree. *Yarumo.*" May 20, 1942, *Richard Evans Schultes 3697* (TYPE in Chicago Museum).

LEGUMINOSAE

Inga macrophylla *Humboldt & Bonpland ex Willdenow* Sp. Pl. 4 (1806) 622.

Inga macrophylla, which ranges from Venezuela to Peru and Bolivia, was first reported from Colombia by Uribe (in Caldasia 3, no. 14 (1945) 347), on the basis of material from the Intendencia del Meta. The second and third Colombian collections, cited below, greatly extend the known range of this species in Colombia. In the Colombian Amazonia, this species, cultivated for the edible pulp around the beans, is called *guava machete* or *guamo machete*. In the Tikuna Indian language, it is known as *pa-má*.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, between El Encanto and the mouth, May 22–28, 1942, *Richard Evans Schultes 3857*.—Comisaría del Amazonas, Leticia. "Bushy shrub. Flowers white. Fruit long. *Guamo machete*. Tikuna: *pa-má*". September 20, 1945, *Richard Evans Schultes 6542*.

Inga setifera *de Candolle* Prodr. 2 (1825) 432, 615.

According to Uribe (in a letter to the writer), *Inga setifera* has not hitherto been reported from Colombia. It is known to be common in the Departamento de Loreto in Peru. In Leticia, the plant is called *chimbillo* by the Spanish-speaking population, *kau-ré* by the Tikuna Indians.

COLOMBIA: Comisaría del Amazonas, Leticia. "Flowers yellow. Pulp of fruit edible. *Chimbillo*. Tikuna: *kau-ré*." September 20, 1945, *Richard Evans Schultes 6543*.

Swartzia bracteosa *Martius ex Bentham* in Martius Fl. Bras. 15, pt. 2 (1870) 20.

A species of the western half of the Amazonia, *Swartzia bracteosa* is now known, through the collection cited below, well within Colombian territory. It is possible that the type was from Colombia, for it was collected by Martius "in sylva Yapurensibus."

COLOMBIA: Intendencia del Amazonas, Río Igaraparaná, los alrededores de La Chorrera, alt. ca. 180 m. "Small tree. Fruit red." June 4–10, 1942, *Richard Evans Schultes 3939.*

VOCHYSIACEAE

Vochysia lomatophylla *Standley* in Field Mus. Publ. Bot. 22 (1940) 150.

Vochysia lomatophylla was described from material collected on the Río Mazán in Loreto, Peru; it has also been known from the Rio Solimões in Brazil (Stafleu in Rec. Trav. Bot. Néerl. 41, bk. 2 (1948) 505). The collections cited below are the first recorded from Colombia and greatly extend the known distribution of the species to the headwaters of the Río Negro basin.

COLOMBIA: Comisaría del Vaupés, Upper Vaupés River, alt. about 300 m. (?) January, 1944, *Gabriel Gutiérrez & Richard Evans Schultes 504.*—Comisaría del Vaupés, Upper Vaupés River, near Miraflores, alt. about 300 m. (?) "Enormous tree on floodland along banks." January, 1944, *Gabriel Gutiérrez & Richard Evans Schultes 701.*

Vochysia obscura *Warming* in Martius Fl. Bras. 13, pt. 2 (1875) 73, t. 13.

Widely distributed in the Amazon basin of Brazil and Peru and in southern Venezuela, this species of savannas and caatinga-forests has not hitherto been reported from Colombia. The collection cited below extends the known range very far to the northwest.

COLOMBIA: Comisaría del Vaupés, Cerro Chiribiquete, January, 1944, *Gabriel Gutiérrez & Richard Evans Schultes 688.*

Vochysia vismiifolia *Spruce ex Warming* in Martius Fl. Bras. 13, pt. 2 (1875) 99.

This species of savannas or open caatinga-like forests is widely distributed throughout the Amazon Valley of Brazil and in southern Venezuela, but has hitherto apparently not been recorded from Colombia.

COLOMBIA: Comisaría del Vaupés, Cerro Chiribiquete, January, 1944, *Gabriel Gutiérrez & Richard Evans Schultes 633*.

EUPHORBIACEAE

Euphorbia penicillata (*Millspaugh*) *R. E. Schultes comb. nov.*

Tithymalus pencillatus Millspaugh in Field Mus. Publ. Bot. 4 (1925) 95.

Although the binomial *Euphorbia penicillata* has been used in several enumerations (Herrera: "Catálogo alfabético de los nombres vulgares y científicos de plantas que existen en el Perú" (1939) 192; Herrera: "Sinopsis de la flora del Cuzco" 1 (1941) 291), it seems that the combination has never properly been made. The specific epithet was originally published as *pencillatus*, an obvious typographical error which was corrected in the index of the volume.

Phyllanthus fluitans *Bentham ex Mueller-Argoviensis* in Linnaea 32 (1863) 36.

Described from Brazil, *Phyllanthus fluitans* has apparently not hitherto been reported from the flora of Colombia.

COLOMBIA: Intendencia del Amazonas, near mouth of Río Loretoyacu, April, 1944, *Frederick J. Hermann 11298*.

PERU: Departamento de Loreto, Río Amazonas, Isla Cacao, April, 1944, *Frederick J. Hermann 11314½*.

Serjania dasyclados *Radlkofer* var. **sibundoya** *R. E. Schultes var. nov.*

Frutex scandens, a *Serjania dasyclados* principaliter foliolis subtus densius tomentoso-pilosis, supra dense et sordide adpresso-pilosis et tactu mollibus differt.

This concept would seem to represent either a southern variant of *Serjania dasyclados* or an endemic variety possibly confined to the mountain-encircled Valley of Sibundoy where a large number of endemic plants have been found. It is at once distinguished from *Serjania dasyclados* by having dense and appressed hairs of a dirty brown color on the upper surface of the leaflets. The more northern collections of the Colombian *Serjania dasyclados* (the type and a cotype from Cundinamarca at 700 and 1000 m. respectively; a collection from Caldas at 1800–2100 m.; one from Santander at 2000–2600 m.; one from Norte de Santander at 2000–2500 m.) have no indumentum on the upper surface of the leaflets.

COLOMBIA: Comisaría del Putumayo, Valley of Sibundoy, Sibundoy, alt. about 2225–2300 m. "Vine. Flowers white; fruits ripen red. Hairs on both leaf surfaces." May 29, 1946, *Richard Evans Schultes & Mardoqueo Villarreal 7652* (TYPE in Herb. Gray).

BOMBACACEAE

Quararibea putumayensis (*Huntreasas* in Lloydia 11 (1948) 186.

This collection is topotypical. The species is known only from the Comisaría del Putumayo and adjacent regions of Peru. The Kofán Indians employ the roots of this bush in preparing arrow-poison.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Flowers white. Fruit edible. Bush. Kofán: *kun-kun-ni-ai.*" March 23–25, 1942, *Richard Evans Schultes 3420.*

Quararibea Schultesii *Cuatrecasas sp. nov.*

Frutex. Ramuli badii, glabri, sublaeves, novelli pallide virides, pilis stellato-pubescentibus vestiti. Folia grandia, membranacea, simplicia, alterna, petiolata, pallide viridia. Petiolus robustus, 1.5–2 cm. longus, teres, dense stellato-tomentosus. Lamina obovata, plusminusve oblonga, basim versus attenuata, basi cuneata, apice subito contracta et cuspidata margine integro; tri-quintuplicinervis, nervis secundariis quattuor, utroque latere duo tertio superiores dispositis ascendentibus prope margine arcuato-anastomosatis reliquis nervis transversis et reticulum formantibus; supra prospectu glabra sed pilis sparsissimis simplicibus munita, nervis principalibus conspicuis, reticulo obsoleto; subtus pilis sparsis simplicibus et stellatis praecipue ad nervos praedita, nervis primariis secundariisque valde eminentibus, reticulo bene eminenti; 18–30 cm. longa, 10–15 cm. lata. Stipulae lanceolatae, 9 mm. longae, 2.5 mm. latae, dense stellato-tomentosae, mox deciduae. Flores solitarii, oppositifolii, pedunculati. Pedunculi mediocres, flexuosi, circa 18 mm. longi, striolati, dense adpresse stellato-tomentosi, apice tres bracteas, late lanceolatas, dense stellato-tomentulosas, circa 1 cm. longas, 2–4.5 mm. latas, basi calycis adnatas ferentes. Calyx tubuloso-conicus; tubus 13 mm. longus, basim versus minute striatus, apice breviter 5-lobulatus, dorso alis quinque membranaceis, apicem versus dilatatis, extremis rotundatis, calycis tubum superantibus instructus, extus tubo alisque stellato-tomentulosis intus adpresse albido-sericeis. Petala 3 cm. longa, supra glabra, subtus villoso-lanata cum pilis stellatis radiis tenuibus longis intricatis, verosimiliter albida; ungui late lineari, glabro, 16 mm. longo; limbo apice exserto, spathulato, 14 mm. longo, 5–6 mm. lato, apice rotundato, reflexo vel patenti. Staminorum columna quam calyx plus duplo longior, glabra, circa 3 cm. longa, ex-

trema in lacinias quinque antheriferas lineares, 4–5 mm. longas producta; laciniis sex antherarum loculis, oblongis, 1–1.2 mm. longis, valde contiguis munitis, et loculis alteris (1–2) parte superiore tubo concrescentibus. Stylus longe villosus, antherarum lobulis parum brevior vel aequilongus. Stigma capitatum, 1.8 mm. crassum.

In connection with the foregoing description, Cuatrecasas states: "*Quararibea Schultesii* belongs to the small group of species which have wings on the calyx. The most similar to it is *Quararibea bracteolosa* (Ducke) Cuatr. but *Q. Schultesii* differs in having longer petioles and pedicels, by its smaller flowers, by the shorter membranaceous calyx of which the wings are more expanded and even more membranaceous, by the herbaceous-membranaceous lanceolate bracts, and by the indumentum of calyx and bracts which is shorter and thinner. *Quararibea bracteolosa*, on the contrary, has bracts which are ovate and coriaceous or subcoriaceous, a calyx tube which is much thicker and dense. I have seen an isotype of *Quararibea bracteolosa* which is preserved at the Chicago Museum of Natural History. Probably *Ducke 1781* and *1782* (fruiting specimens), distributed as *Quararibea bracteolosa*, do not belong to that species."

COLOMBIA: Comisaría del Amazonas, Trapecio amazónico, Loretoyacu River, alt. about 100 m. "Bush." October 20–30, 1945, *Richard Evans Schultes 6669A* (TYPE in Chicago Museum).

OCHNACEAE

Rhytidanthera magnifica (*Gleason*) *Dwyer* in Lloydia 9 (1946) 53, t. 2, a–g.

In his monographic treatment of *Rhytidanthera* and related genera, Dwyer (loc. cit.) reported but one collection of *R. magnifica*, the type, *Lawrance 599*, from the El Umbó region, Departamento de Boyacá.

Cuatrecasas 13370 extends the known range of *Rhyti-*

danthera magnifica into the Departamento Norte de Santander and very near to the Venezuelan boundary. Although the type was described as a tree up to 65 feet tall, the species may also be, as reported by Cuatrecasas, a small tree ("arbolito"). Dwyer states that *Rhytidanthera magnifica* "is readily distinguished from the two other species. . . . by its narrower leaflets which taper toward the base. . . .", but the leaflets of *Cuatrecasas 13370*, while very narrow, are broadly rotund at the base.

COLOMBIA: Departamento Norte de Santander, región del Sarare, hoya del río Marque entre Junín y Córdoba, 920–1240 m. alt. "Arbolito. Pétalos blancos. Estambres amarillos." November 22, 1941, *J. Cuatrecasas 13370*.

Rhytidanthera mellifera *R. E. Schultes sp. nov.*

Arbor parva, usque ad quindecim pedes alta, ramosissima. Truncus tres ad quattuor pollices in diametro, rufobrunneo cum cortice ruguloso et minute lenticellato. Folia imparipinnata, aliquid pendula; petioli 16.5–24.5 cm. longi; foliola duodecim vel plerumque tredecim (cum petiolulis 1–2 mm. longis), lateralia alterna, 2.2–2.5 cm. distantia, anguste lanceolata, apice acuta, basi rotundata, 8.5–14 (plerumque 10.5) cm. longa, 2.2–3.2 (plerumque 2.5) cm. lata; foliolum terminale liberum, cuneato-lanceolatum, apice obtusum, 10–12 cm. longum, usque ad 4 cm. latum; alia marginem versus valde retrocurvata, margine grossiuscule serrata, dentibus apice incurvis et plerumque 6 mm. distantibus, supra nitida venis non elevatis, subtus pallidiora, venis prominenter elevatis, secundariis plusminusve viginti; stipulis caducis. Inflorescentiae terminales, parvae, quam folia multo breviores, 20 cm. longae, rhachide 3 mm. in diametro, pauciflorae (floribus usque ad viginti); rhachidis rami usque ad 8 cm. longi; pedicelli ad rhachidem articulati, robustiores et lignosi, usque ad 10 mm. longi, apice subclavati, basi 1 mm. et apice 2 mm. in diametro. Flores

solitarii, aromatico-fragrantes, mucilaginosi, alabastris 16 mm. longis, 7–8 mm. latis. Sepala quinque, imbricata, concava; duo exteriora subcoriacea sed marginem versus membranacea, rotundata, margine irregulariter lacerata, apice profunde retusa, supra minute pulverulento-striolata (non strigillosa), 7 mm. longa, 7 mm. lata, basi cum plusminusve quindecim glandulis minutis digitaliformibus, usque ad 1 mm. longis, 0.25 mm. in diametro; interiora majora, membranacea vel apicem versus aliquid papyracea, oblonga, apice profundissime fissa, margine integra (vel sepalo extimo minute lacerato), 13 mm. longa, 7 mm. lata. Petala quinque, alba, membranacea, leviter inaequalia, oblongo-spathulata, apice saepe obliqua (alabastrum aliquid subcucullliforme), margine integra, 17 mm. longa, 7 mm. lata. Stamina sexaginta quattuor, brunneo-flava, subaequalia, usque ad 12 mm. longa. Antherae 10 mm. longae, 0.8 mm. latae, longitudinaliter rugulosae, filamentis 2 mm. longis, basi 0.6 mm. latis. Ovarium crassum, nigrum, inverse claviforme, apicem versus in stylum indeterminatum, apparenter erectum, luteum, paulatim angustans, 13 mm. longum, 2.5 mm. in diametro, quinque cum stigmatibus sessilibus. Capsulae immaturae solum visae, usque ad 2 cm. longae, 2.5–3 cm. latae, praecipue apicem versus anguste subfalcatae.

Rhytidanthera, closely allied to *Godoya*, is the only compound-leaved genus of the *Ochnaceae*. Hitherto, there have been but three species known: *Rhytidanthera magnifica*, *R. splendida* and *R. sulcata*. The genus is endemic to Colombia.

Rhytidanthera mellifera represents the first collection of the genus from the Amazon Valley, the other species being Andean in their distribution. This is an excellent example of the curious type of plant distribution and relationship of the plants on the arc which forms the so-called Venezuelan-Guianan land-mass. Of this distribu-

tion, Dr. Lyman B. Smith (in Contrib. Gray Herb. no. 161 (1946) 31) has said: ". . . . movement on the arc was from the Andean region eastward. Finally most of the species [i.e. of certain bromeliads and cyperaceous plants he was discussing] are narrow endemics, indicating that the movement was relatively ancient."

Rhytidanthera mellifera is an endemic of the cretaceous, quartzite hills of the upper Apaporis basin. We might well expect *Rhytidanthera* to occur in collections from other sandstone mountains in eastern Colombia and southern Venezuela, but even now we may venture to say that it is not a common element of the flora of these repositories of endemics. On the Cerro Castillo, *Rhytidanthera mellifera* is extremely rare. Special search for more abundant flowering material failed to furnish additional individuals, so the species is at present known only from one bush. This bush, growing on the edge of a rock-ledge covered with a scrubby vegetation, was visible to us far below as we were climbing the face of the mountain. Like the other species of the genus, it makes an unusual display with the large, white caesalpinaceous-like flowers. *Rhytidanthera* was not seen on the nearby mountains, Chiribiquete and Campana.

Rhytidanthera mellifera, so named because of the sweet and mucilaginous exudation of the flower which attracts swarms of wild bees to the plant, is immediately set apart from the other known species by having 64 stamens, a much larger number than has hitherto been found in the genus.

The closest ally of *Rhytidanthera mellifera* would appear to be *R. magnifica* (Gleason) Dwyer, from which it differs in having twelve or thirteen alternate (instead of nine or ten opposite) leaflets; a very broadly cuneate-lanceolate, obtuse (instead of a narrowly lanceolate-elliptic, acute) terminal leaflet; much smaller lateral

leaflets; minutely lacerate (instead of entire) sepals; smaller outer and larger inner sepals; and generally smaller petals which, in the bud, are subcucullate at the apex. There are also minor floral and vegetative differences which more abundant material may show to be of importance.

COLOMBIA: Comisaría del Caquetá, Apaporis River, Cerro Castillo (below confluence of Ajaju and Macaya), quartzite base, alt. of collections 350–1000 feet above the forest floor, 1250–1900 feet above sea-level. "Flowers white, centres yellow-brown, aromatic fragrant. Treelet 15 feet. On exposed rock. Much branched. Basal diameter 3–4 inches. Leaflets very coriaceous, marginally inrolled." July 27, 1943, *Richard Evans Schultes 5657* (TYPE in U.S. Nat. Herb.).

Sauvagesia erecta *Linnaeus* Sp. Pl. (1753) 203.

Sauvagesia erecta, the most widespread species of the genus, is rather variable and presents several general geographical variants. It has been collected in Colombia in the Departamentos de Norte de Santander, Huila, Tolima and Cauca (Dwyer in Bull. Torr. Bot. Club 72 (1945) 530). The collection cited below is apparently the first from the entire Amazon basin of Colombia. There are numerous collections from the adjacent Amazonian regions of Brazil and Peru.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, near La Chorrera, alt. about 180 meters. "Small shrub under 8 inches tall. Flowers pinkish." June 4–10, 1942, *Richard Evans Schultes 3955*.

FLACOURTIACEAE

Lindakeria nitida *Killip & R. E. Schultes sp. nov.*

Arbuscula usque ad viginti quinque pedes alta, ramosissima, ramis longis laxisque. Folia ovata, basi cuneato-obtusa, apice attenuato-acuminata, integerrima, 10.5–14 cm. longa, 4.5–5.5 cm. lata, supra nitidissima, vivo apparenter atroviridia cum venis non conspicuis, subtus aliquid pallidiora cum venis prominentibus, utrinque glaberrima, nervis secundariis plusminusve quinque. Pet-

ioli 2.5–3.5 cm. longi, teretiusculi, ad laminam incrassati. Racemi axillares, apparenter erecti et stricti; rhachides usque ad 10 cm. longae, folia subaequantes, compresso-angulatae. Pedicelli distichi, 6–7 mm. longi, solitarii vel saepe duo vel tres. Flores 10 mm. in diametro vel minores, alabastro globoso. Sepala tria, triangularia, apice subacuta, margine valde involuta, 4.5 mm. longa, basi 4 mm. lata, extus apparenter minute aspero-pustulata et basi pilosa. Petala sex, alba, membranacea, lanceolata, apice acuta, 7 mm. longa, 1.8 mm. lata, extus rarenter dense albido-leprosa. Stamina plusminusve quadraginta, 4–5 mm. longa; filamenta libera, laxa, aliquid complanato-filiformia, 2 mm. longa; antherae lineares, 2.5–3 mm. longae. Ovarium ovoideum, echinato-tuberculatum, 2 mm. in diametro. Stylus ovario circiter duplo longior, 3.5–3.8 mm. longus, complanato-filiformis, glaber, stigmate minute trilobo. Fructus adhuc ignotus.

Lindakeria nitida is at once distinguished from all other species of the genus by its very long and lax inflorescence which gives the plant a completely unique aspect. This species, growing in the Magdalena watershed of Colombia, is perhaps most closely allied to the rather widespread Amazonian *Lindakeria maynensis*. In addition to the length of its inflorescence and its highly lustrous leaves, *Lindakeria nitida* differs from *L. maynensis* in the shape and size of the sepals and slightly in the structure of the stamens.

The collection *Haught 1917* has, in general, much larger leaves and flowers than the type. The leaves of this cotype are lanceolate-ovate, up to 26 cm. long and 8 cm. wide; the petioles measure up to 7 cm. in length, and the rachis is 16 cm. long. Additional collections will be needed before we can determine whether the type represents the normal condition of the species, but it would appear from an examination of the available ma-

terial that *Haught 1917* was taken from an individual in an open, favorable site or else from a new flush.

COLOMBIA: Departamento El Magdalena, 17 km. north of El Banco on road to Chimichagua. "Large (5 m. high) shrub with many long, lax branches. Inflorescence very conspicuous. Corolla white, anthers yellow. In swampy forest, along road." August 3, 1938, *Oscar Haught 2221* (TYPE in U.S. Nat. Herb. No. 1706900).—Departamento de Santander, El Centro, vicinity of Barranca-Bermeja, Magdalena Valley, between Sogamoso and Carare Rivers, alt. 100–500 meters. "Large shrub (4 m.) very conspicuous white flowers and buds." August 26, 1936, *Oscar Haught 1917*.

Mayna glomerata *Killip & R. E. Schultes sp. nov.*

Arbor parva, usque ad duodecim pedes alta. Rami ramulique verrucoso-striati, griselli; ramuli juveniles cinereo-virides, squamiferi. Folia alterna, simplicia, lanceolato-elliptica, usque ad 22 cm. longa (sine petiolo), 7–7.5 cm. lata, integra, apice longe acuminata, basi cuneata, chartacea, nervis secundariis valde arcuatis duodecim vel tredecim, omnino glabra, supra atroviridia et apparenter nitida cum nervis leviter prominentibus sed non elevatis, infra pallide viridia, non nitida, nervis valde elevatis et fulvis. Petioli robusti, usque ad 3 cm. longi, 1.5–1.8 mm. in diametro, glabri. Stipulae non visae. Dioecia. Flores in fasciculis caulinis, glomeratis, inflorescentiis usque ad plusminusve decemfloris. Alabastra globosa vel elongato-globosa, plusminusve 2 mm. in diametro, minute et subdense pilosa. Bracteae minutae. Pedunculus usque ad 3 mm. longus, dense albo-pilosus. Flores staminiferi albi, conspicui, usque ad 2 cm. in diametro. Sepala tria, leviter inaequalia, valde concava, ovata, integra, apice subacuta, extus pubescentia, intus glabra, quinque cum venis brunneis longitudinaliter strigata, sepalum majus 3.8–4 mm. longum, 2.7–2.9 mm. latum. Petala quinque ad septem, aequalia, subspathulata, margine irregularia, apice late rotundata et valde involuta, alba, membranacea, usque ad 6.5 mm. longa, apice

circiter 2 mm. lata, basi 0.4 mm. lata, omnino glabra. Stamina circiter vigintiquinque, 2.6 mm. longa, filamentis liberis, erectis, plerumque 0.8 mm. longis, et antheris leviter arcuatis, 1.8 mm. longis, 0.5 mm. latis, flavis, apice poricidis. Fructus adhuc ignotus.

Mayna glomerata is easily distinguished from the other species of this genus by its unusual inflorescences which are in small, closely packed, glomerate fascicles. There are other notable differences, as well, such as the curious folding of the upper third of the petals, the shape of the petals, and the number of the stamens.

COLOMBIA: Departamento de Santander, vicinity of Barranca Bermeja, Magdalena Valley, between Sogamoso and Carare Rivers, Viscania Creek, 32 km. south of El Centro, at about 100 meters alt. "Small tree, about 4 m. high. Flowers white with yellow centres, showy, closely covering twigs." November 14, 1936, *Oscar Haught 2070* (TYPE in U.S. Nat. Herb. No. 1742337).

Mayna longifolia *Poeppig & Endlicher* Nov. Gen. ac Sp. 3 (1845) 64, t. 271.

Mayna longifolia is extremely abundant in the forests of the southern half of the *trapecio* in areas above flood-level. The collection *Llewelyn Williams 2711* from La Victoria (now "Granja Caldas") near Leticia, cited as from Peru in Macbride's "Flora of Peru" (Field Mus. Publ. Bot. 13, pt. 4, (1941) 18), but actually from Colombian territory, is referable to *Mayna longifolia*.

COLOMBIA: Comisaría del Amazonas, Trapecio amazónico, Loretoyacu River, alt. about 100 m. "Treelet 25 feet." October 1945, *Richard Evans Schultes 6700.*—Comisaría del Amazonas, same locality and date. "Tall treelet. Leaf larger than normal." *Richard Evans Schultes 6701.*—Comisaría del Amazonas, same locality and date. "Leaves very narrow. Fruit on trunk up to top." *Richard Evans Schultes 6705.*

COMBRETACEAE

Combretum laxum *Jacquin* Enum. Pl. Carib. 19 (1760) 115.

Combretum laxum appears to be an aggregate species in which several clearly distinct "tendencies" can be seen. As now understood in this broad sense, the species occurs all over tropical America. Several collections from the Departamento de Loreto, Peru, represent the same variant as *Schultes 3924* from adjacent Colombia. When further material is studied, this variant can probably be shown to be specifically distinct from true *Combretum laxum*.

In the Igaraparaná, the Witoto Indian name of *Combretum laxum* is *ajuo-ro*. In another Witoto dialect from Loreto, Peru, the native name has been recorded as *aioho-ayo-o* (in Field Mus. Publ. Bot. 13, pt. 4 (1941) 225).

This attractive vine often covers riverside vegetation and, especially at night, gives off an extraordinarily strong and sweet perfume.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, alrededores de La Chorrera. "Vine. Flowers yellow, fragrant." June 4–10, 1942, *Richard Evans Schultes 3924*.

MELASTOMACEAE

Aciotis aequatorialis *Cogniaux* in Martius Fl. Bras. 14, pt. 3 (1885) 464.

Known from the Pacific coast of Colombia, from Antioquia and from the Intendencia del Meta, *Aciotis aequatorialis* has hitherto apparently not been reported as an element of the flora of Amazonian Colombia. *Aciotis polystachys* (Bonpl.) Tr. and *A. purpurascens* (Aubl.) Tr. have been collected in Colombia only a few kilometers from the locality of the specimen of *A. aequatorialis* cited below.

COLOMBIA: Intendencia del Amazonas, Río Hamacayacu, April, 1944, *Frederick J. Hermann 11303*.

Leandra divaricata (*Naud.*) *Cogniaux* in Martius Fl. Bras. 14, pt. 4 (1886) 196.

Not infrequent in British Guiana, Venezuela, Amazonian Peru and elsewhere in Colombia, *Leandra divaricata* has been collected hitherto on the Amazonian watershed of Colombia but twice: at Puerto Porvenir, on the upper reaches of the Río Putumayo (*Cuatrecasas 10666*), and at Mocoa (*Cuatrecasas 11316*). *Hermann 11308*, from the southeasternmost point of the Colombian Amazonia, would seem to indicate a wide distribution for this species in eastern Colombia.

COLOMBIA: Intendencia del Amazonas, Río Hamacayacu, April, 1944, *Frederick J. Hermann 11308*.

LOGANIACEAE

Strychnos amazonica *Krukoff* in Brittonia 4 (1942) 284.

This collection, determined with some reservation as representing *Strychnos amazonica*, is the first of the species from Colombia. Krukoff and Monachino (in Caldasia 4 (1946) 45) enumerated *Strychnos amazonica* as a species to be expected in the Colombian Amazonia. It is one of the plants the root of which is used by the Kofán Indians in preparing arrow-poison.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in Kofán Indian arrow-poison. Kofán name: *hesspá-chu.*" April 25, 1942, *Richard Evans Schultes 3689*.

Strychnos Erichsonii *Richard Schomburgk* Faun. Fl. Br. Guiana (1848) 1082, *nomen:* ex Progel in Martius Fl. Bras. 6, pt. 1 (1868) 274.

First reported from Colombia on the basis of a collection from the Río Sucumbíos (in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 290), *Strychnos Erichsonii* is apparently one of the most abundant species of this genus in the upper Putumayo basin where it is sought by the Kofán Indians for use in preparing *curare*.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Bark of stem rasped and used for arrow-poison. Kofán name: *ee-ru-che.*" April 25, 1942, *Richard Evans Schultes 3682.*—Same locality and date. "Vine. Root used in arrow-poison. Kofán name: *see-a-se-sep.*" *Richard Evans Schultes 3682.*—Same locality and date. "Vine. Pieces of stem used in preparing Kofán arrow-poison. Kofán name: *mun-tai-rú-chee.*" *Richard Evans Schultes 3685.*

Strychnos guianensis (*Aubl.*) *Martius* Syst. Mat. Med. Bras. (1843) 121.

Known from Colombia previously from one collection made in the Río Vaupés, *Strychnos guianensis* is now registered from the southwesternmost point of the Amazon basin of Colombia where it serves the Kofán Indians as one of the lesser ingredients in arrow-poisons.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in preparing *curare.* Kofán name: *ku-see-ye-hé-pa.*" April 25, 1942, *Richard Evans Schultes 3688.*

Strychnos javariensis *Krukoff* in Brittonia 4 (1942) 279.

The following collections are apparently the first to be recorded from Colombia. The species is one of the lesser ingredients of Kofán *curare.*

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in arrow-poison. Kofán name: *tzu-se-hé-pa.*" April 25, 1942, *Richard Evans Schultes 3690.*—Same locality and date. "Vine. Root used in Kofán arrow-poison." *Richard Evans Schultes 3691.*

Strychnos Jobertiana *Baillon* in Adansonia 12 (1879) 367.

Although previously reported from two localities in the Colombian Amazonia, *Strychnos Jobertiana* is now known to be very abundant in the upper Putumayo basin and to be one of the preferred ingredients of *curare* amongst the Kofán Indians.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Stem employed as ingredient in arrow-poison. Kofán name: *u-su-se-é-pa.*" April 25, 1942, *Richard Evans Schultes 3692.*—Same locality and date. "Vine. Root used to make arrow-poison. Kofán name: *fee-see-pá-chu.*" *Richard Evans Schultes 3695.*

Strychnos Peckii *B. L. Robinson* in Proc. Am. Acad. 49 (1913) 504.

This is the second collection of *Strychnos Peckii* from Colombian Amazonia. It is one of the preferred species amongst the Kofán Indians for preparing arrow-poison.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in arrow-poison. Kofán name: *su-he-sé-pa.*" April 25, 1942, *Richard Evans Schultes 3684.*

Strychnos subcordata *Spruce ex Bentham* in Journ. Linn. Soc. 1 (1856) 106.

This species has never been reported from Colombia. It is considered one of the strongest of the *curare* ingredients by the Kofán Indians.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Vine. Root used in arrow-poison formula. Kofán name: *su-sé-pe.*" April 25, 1942, *Richard Evans Schultes 3687.*

APOCYNACEAE

Himatanthus articulata (*Vahl*) *Woodson* in Ann. Missouri Bot. Gard. 25 (1937) 196.

The collection cited below is apparently the second from Colombia, the first being *Cuatrecasas 9001* from Florencia, capital of the Comisaría del Caquetá. The species is rather widespread in the Guianas, Amazonian Brazil, the Orinoco drainage-area of Venezuela and in Middle America.

COLOMBIA: Comisaría del Vaupés, Cerro Chiribiquete. "Flowers white." January, 1944, *Richard Evans Schultes 5735.*

Himatanthus bracteata (*A. DC.*) *Woodson* in Ann. Missouri Bot. Gard. 25 (1937) 200.

Known from British Guiana and several stations in the Amazon of Brazil (where it is apparently most abundant in the Rio Negro basin) as well as from Pernambuco and Bahía, *Himatanthus bracteata* has hitherto not been reported from Colombia. *Schultes 5814*, tentatively determined as representing this species, has, according to Woodson, leaves which "are larger than usual." In the Vaupés, the plant is known as *platanote*, due to the superficial resemblance of the fruit to the banana.

COLOMBIA: Comisaría del Vaupés, Cerro Chiribiquete. "Flowers white." January, 1944, *Richard Evans Schultes 5738*.—Comisaría del Vaupés, Río Vaupés, Caño Pacú (below Cerro Circasia). "Small tree up to 15 feet tall. Latex abundant, white. *Platanote*." March 6, 1944, *Richard Evans Schultes 5814*.

Mandevilla nerioides *Woodson* in Ann. Missouri Bot. Gard. 28 (1941) 274.

Mandevilla nerioides is known only from the Intendencia del Meta and the Comisaría del Vaupés in Colombia. The type collection was made on the Guaviare River at San José del Guaviare by Cuatrecasas. The following collections establish the occurrence of this endemic species on the summit of the remnant quartzite hills of the upper Apaporis River which have, in common with the hills at San José del Guaviare, a number of striking endemic elements.

COLOMBIA: Comisaría del Vaupés, Cerro Chiribiquete. "Vine. Flowers pink. Latex white, sticky." May 15–16, 1943, *Richard Evans Schultes 5442*.—Same locality. "Vine. Flowers pinkish white. Latex white." January, 1944, *Richard Evans Schultes 5740*.

SOLANACEAE

Solanum quitoense *Lamarck* Illustr. 2 (1793) 16.

Although the *lulo*, the fruit of this species, is known

in many parts of southern Colombia and has been the subject of several recent articles (Chalons in Agric. Amer. 4 (1944) 110–112; McCann, ibid. 7 (1947) 146–149; Hodge in Rev. Fac. Nac. Agron. 7 (1947) 147–154; Hodge in Journ. N.Y. Bot. Gard. 48 (1947) 155–159), there are apparently no Colombian collections of *Solanum quitoense* in the larger herbaria of Colombia and the United States.

The lulo is used as a fruit and is cultivated in much of Andean Colombia (Hodge, loc. cit.), especially in the southern part of the country—in El Valle, Cauca and Nariño (Pérez-Arbelaez, "Plantas medicinales y venenosas de Colombia" (1937) 246; "Plantas útiles de Colombia" (1947) 451), where it is known also as *naranjillo* and *toronja*. Lacking specimens or a critical taxonomic study of the lulo from the numerous areas of Colombia, we cannot be certain that only one species is involved.

Solanum quitoense, as represented in our herbaria, is rather common in the Andean highlands of Ecuador and Peru. The collections *Schultes & Villarreal 7616* and *Schultes 3271* from the southernmost Andes of Colombia not far from the boundary of Ecuador are taxonomically indistinguishable from the material from Ecuador and Peru. It is obvious that an extensive taxonomic study of the lulo in Colombia is needed. Certainly the possibilities of this delicious fruit would indicate the advisability of such an investigation.

COLOMBIA: Comisaría del Putumayo, Valley of Sibundoy, Sibundoy, alt. about 2225–2300 m. "Large shrub. Stem and under surface of leaf purplish, hairy. Flowers white, anthers yellow. Fruit orange colored and size of oranges. *Naranjillo*. Kamsá Indian name: *ma-shakve*." May 29, 1946, *Richard Evans Schultes & Mardoqueo Villarreal 7616*.—Same locality, February 16, 1942, *Richard Evans Schultes 3271*.—Departamento de Antioquia, Río Negro, "La Granja." Cultivated, November 2, 1946, *W. H. Hodge 6712*.

Rubiaceae

Rondeletia rupicola *R. Schumann* var. **chiribiquetana** *R. E. Schultes var. nov.*

Frutex a *Rondeletia rupicola* stipulis foliaceis multo minoribus; foliis elliptico-lanceolatis (non longe lanceolatis), minoribus, 4–5 cm. longis, 1–1.3 cm. latis (non 5–8 cm. longis, 1.5 cm. latis), acutis (non acutissimis, mucronatis), supra prominentius bullatis, prope nervos majores densius sericeo-strigillosis, subtus prope nervos atque in lamina ipsa maxime densissime sericeo-strigillosis; corollae laciniis majoribus, extus densius strigillosis; antheris majoribus; fornicibus papillosis majoribus densissime hirsutis differt. Capsula globosa, coriacea, 2 mm. in diametro, in fructu calycis laciniis usque ad 1.5 mm. longis densissime strigillosis coronata, fusco-brunnea; semina numerosissima, minuta, angulata.

A study of the original description of *Rondeletia rupicola* and an examination of a duplicate type (*Spruce 3392*) preserved at the Gray Herbarium and a photograph of the Spruce specimen at Berlin indicate that there are a number of minor variations which serve to separate the new variety described above. The capsule of *Rondeletia rupicola* is unknown, but the type of var. *chiribiquetana* has both flowers and fruit. The color of the flowers of *Rondeletia rupicola* is not designated; that of var. *chiribiquetana* is pink.

Colombia: Comisaría del Vaupés, Macaya-Ajaju River confluence, Mount Chiribiquete, quartzite base, summit 800–1200 feet above forest floor, 1700–2100 feet above sea level. "Flowers rose-pink. Leaves dark green above, pale below. Hair silvery. Shrub." May 15–16, 1943, *Richard Evans Schultes 5448* (Type in Herb. Gray).

Compositae

Clibadium asperum (*Aubl.*) *de Candolle* Prodr. 5 (1836) 506.

This species of *Clibadium* is abundantly cultivated in the vicinity of La Pedrera and in the Río Miritiparaná for use as a fish-poison. It is known locally as *guaco* by the Spanish-speaking inhabitants and as *kú-na-pe* by the Miraña Indians. Several other species of *Clibadium* are widely cultivated in the Amazon regions as fish-poisons.

COLOMBIA: Comisaría del Caquetá, Río Caquetá, vicinity of La Pedrera, April, 1944, *Richard Evans Schultes 5879*.

Gongylolepis maroana *Badillo* in Bot. Soc. Venez. Ciénc. Nat. 8 (1943) 237.

Recently, two stations for this species were reported for Colombia, both in the Comisaría del Vaupés (in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 310). The collection cited below is the third from Colombia and extends the known range of the plant to the west on the same interrupted sandstone hills on which previously reported collections were made.

COLOMBIA: Comisaría del Vaupés, Ajaju River, Cerro de La Campana, quartzite base, summit about 800–1200 feet above forest floor, 1700–2100 feet above sea-level. "Composite shrub. Common on top of mountain," June 1–6, 1943, *Richard Evans Schultes 5568*.

ILLUSTRATIONS

EXPLANATION OF THE ILLUSTRATION

PLATE VII. (Upper figure). Habit photograph of CECROPIA PORVENIRENSIS *Cuatr.*, Puerto Porvenir, Río Putumayo, Colombia.

(Lower figure). Flowering branch of VOCHYSIA LOMATOPHYLLA *Standl.* the tree from which *Gutiérrez & Schultes 701* was collected, Río Vaupés, Colombia.

Photographs by R. E. SCHULTES

Plate VII

EXPLANATION OF THE ILLUSTRATION

PLATE VIII. RHYTIDANTHERA MELLIFERA *R. E. Schultes*. 1, leaf one half natural size. 2, inflorescence, one half natural size. 3, flower, natural size. 4, stamen, about four times natural size. 5, anther tip showing apical pores, about twenty times natural size.

Drawn by E. W. SMITH

RHYTIDANTHERA

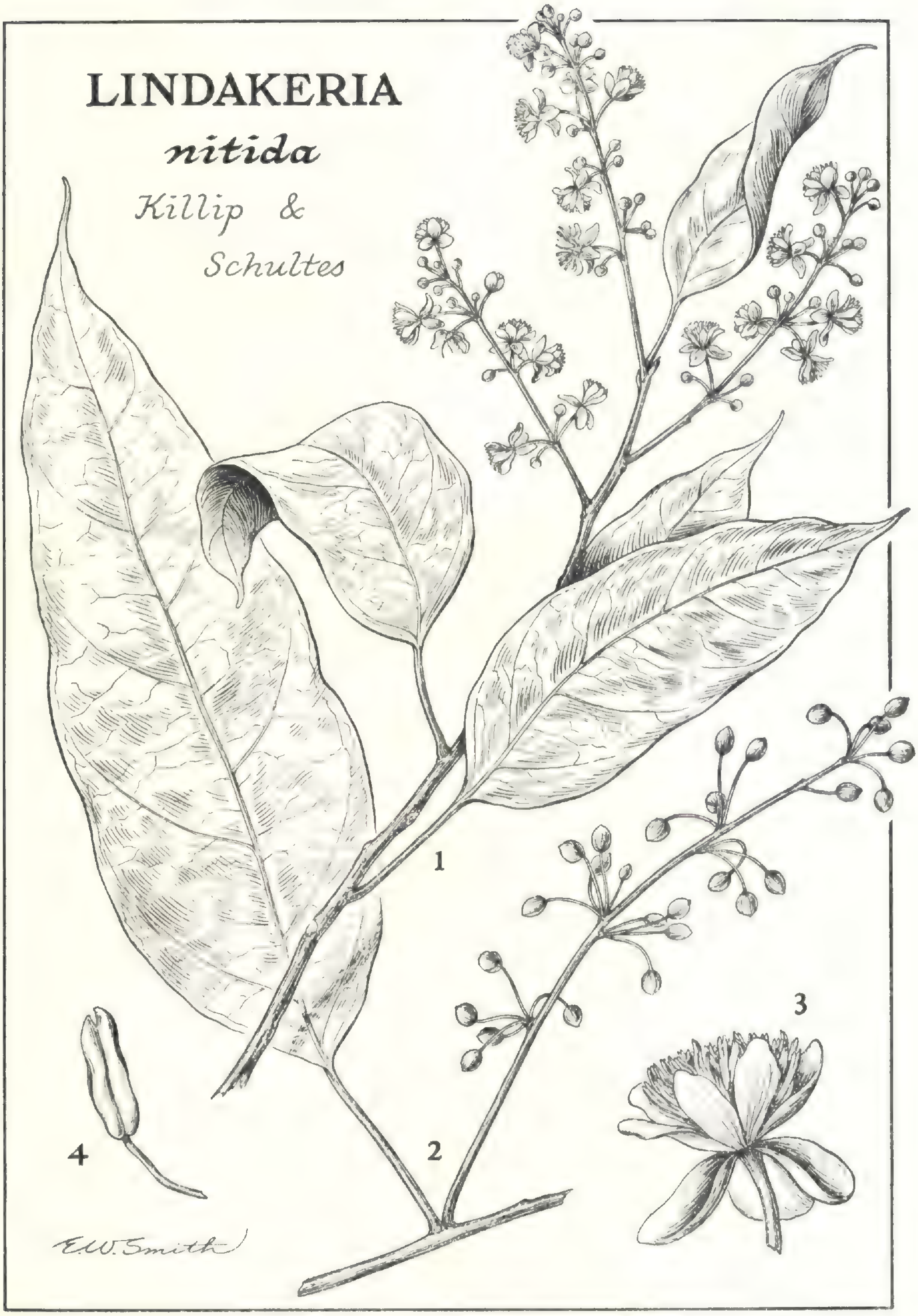
mellifera

R. E. Schultes

EXPLANATION OF THE ILLUSTRATION

PLATE IX. LINDAKERIA NITIDA *Killip & Schultes*. 1, flowering branchlet (*Haught 2221*), one half natural size. 2, budding branchlet (*Haught 1719*), one half natural size. 3, flower, about two and one half times natural size. 4, stamen, about five times natural size.

Drawn by E. W. SMITH


LINDAKERIA
nitida
Killip &
Schultes
1
2
3
4
E.W. Smith

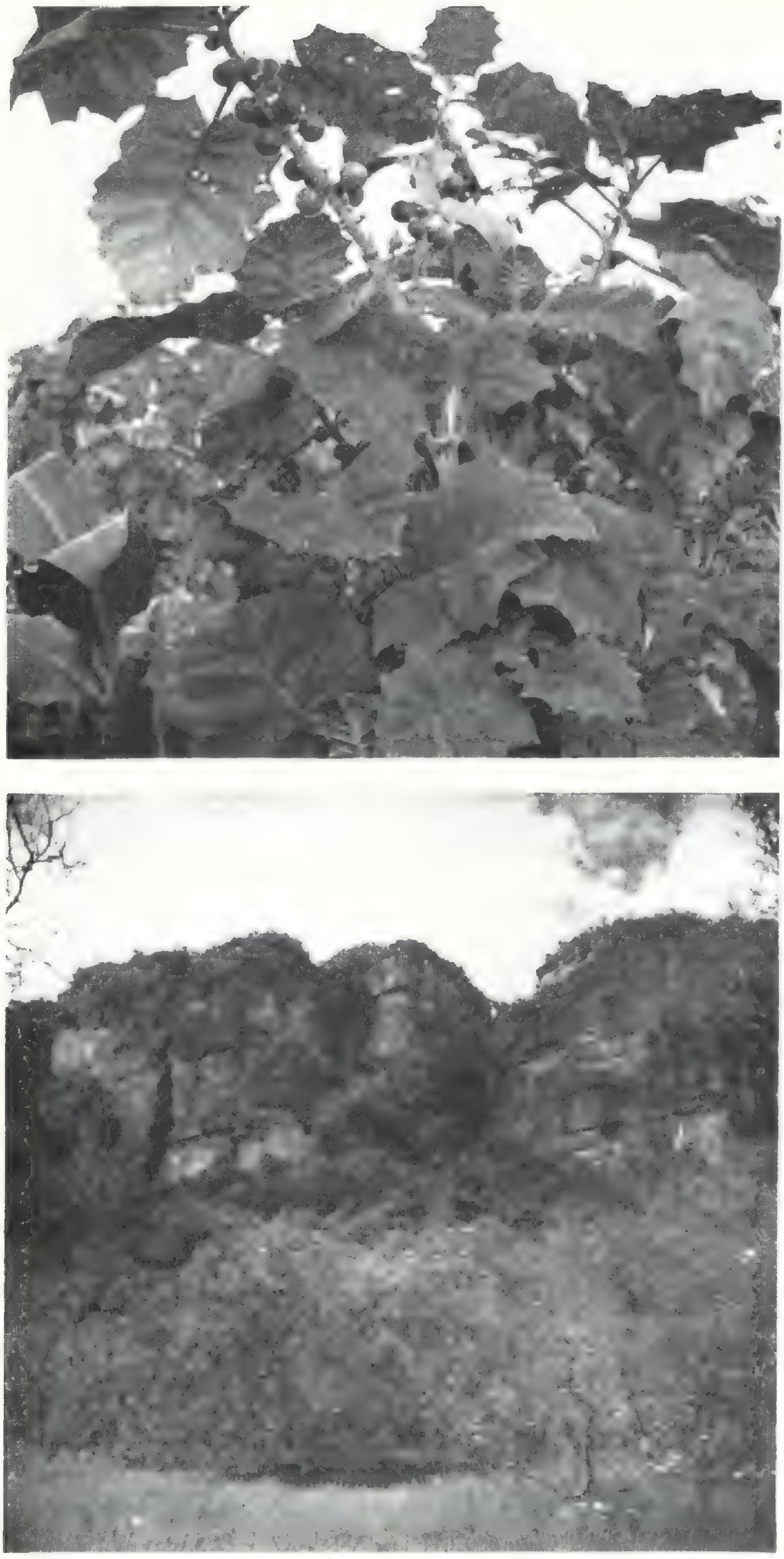
EXPLANATION OF THE ILLUSTRATION

PLATE X. (Upper figure). SOLANUM QUITOENSE *Lam.* Photograph of the plant from which *Schultes & Villarreal 7616* was collected.

(Lower figure). An escarpment of Cerro del Castillo, Río Apaporis, Colombia. RHYTIDANTHERA MELLIFERA occurs on these open, exposed quarzitic escarpments.

Photographs by R. E. SCHULTES

PLATE X



EXPLANATION OF THE ILLUSTRATION

PLATE XI. MAYNA GLOMERATA *Killip & Schultes*. 1, flowering branchlet, one half natural size. 2, flower, about three times natural size.

Drawn by E. W. SMITH

Plate XI

MAYNA *glomerata*

Killip & Schultes

BOTANICAL MUSEUM LEAFLETS
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NOMENCLATURAL NOTES AND NEW CONCEPTS OF TROPICAL AMERICAN ORCHIDS

BY

CHARLES SCHWEINFURTH

DURING the course of recent studies, I have found it necessary to make numerous changes in the status of published concepts, to amplify certain descriptions and to describe several orchids which appear to be new. This addition to the number of recorded species and varieties, together with many similar ones, shows that tropical America from the northern boundary of Mexico to the southern borders of Peru and Brazil is a veritable storehouse of plants new to science. Only the collector and the taxonomist are necessary to bring these to light.

The arrangement of the species follows the order proposed by Dr. Rudolf Schlechter in "Notizblatt des Botanischen Gartens u. Museums Berlin-Dahlem 9 (1926) 563-591.

Cranichis ciliilabia *C. Schweinfurth sp. nov.*

Herba terrestris, gracilis. Folia plura, plerumque basalia et petiolata; lamina ovata, acuta vel breviter acuminata, parva. Caulis basi glaber, supra dense glanduloso-pubescens, vaginis pluribus remotis ornatus. Inflorescentia laxe pluriflora cum floribus parvis membranaceis. Sepala elliptica vel ovalia, acuta. Petala oblique elliptica, pro genere lata, dense ciliata. Labellum simplex, cuneato-

obovatum, antice late rotundatum, concavum, dense longe ciliatum. Columna perbrevis.

Plant terrestrial, slender, about 21.5 cm. tall. Roots tuberous, fasciculate, slender, lanuginose. Leaves several, the four basal blades rosulate, slender-petioled; lamina ovate, acute or short-acuminate, broadly cuneate to subtruncate at the base, commonly 3.2–3.5 cm. long, up to 2.2 cm. wide; petiole channelled, slightly dilated above and below, about 2 cm. or less long. A fourth similar but sessile leaf rises near the base of the stem. Stem slender, glabrous in the lower portion, densely glandular-pubescent above, bearing four distant sheaths of which the lower ones have a close long-sheathing tubular base and the lowermost is dilated into a small foliaceous blade. Raceme loosely 17-flowered, about 4.5 cm. long, with the apical portion (bearing immature flowers) nodding. Flowers small, but medium-sized for the genus, membranaceous. Sepals very sparingly glandular-pubescent on the outer surface. Dorsal sepal elliptic, acute, concave, 3-nerved with the lateral nerves branching below, about 5.9 mm. long and 3.2 mm. wide when expanded. Lateral sepals oval, acute, concave, 5-nerved, about 5.6 mm. long and 3.2 mm. wide. Petals obliquely elliptic, acute or subacute, 4-nerved, densely ciliate with the cilia longer on the anterior margin, about 5 mm. long and 2.7 mm. wide. Lip simple, cuneate-obovate, broadly rounded in front, minutely acute at the apex, densely long-ciliate, about 4 mm. long and 3 mm. wide near the front in natural position, rather deeply concave especially above, 3-nerved, the lateral shorter nerves recurved in the middle of the lamina and having two or three short recurved branches. Column very short, with the stalk of the anther arising near the base.

The long-ciliate lip seems to be unique in the genus and the ciliate petals are remarkably broad.

Mexico: Chiapas, at 4000–6000 feet altitude, "moist bank of trail above Liquidambar," flowers white, November 9, 1945, *A. J. Sharp 45977* (Type in Herb. Ames No. 65446).

Pleurothallis Broadwayi *Ames* Orch. 2 (1908) 267.
Pleurothallis guadalupensis Cogniaux in Urban Symb. Antill. 6 (1909) 432.
Pleurothallis Williamsii Ames Orch. 7 (1922) 120.
Pleurothallis nana A. & S. in Sched. Orch. 8 (1925) 29.

The above synonymy, except for *Pleurothallis nana*, has already been published (C. Schweinfurth in Bot. Mus. Leafl. Harvard Univ. 8 (1940) 41).

At the time when *Pleurothallis nana* was erected, it was thought to be distinct from the concepts referable to *P. Broadwayi*. It seemed to have longer and more branched stems than the other species of this group. It also appeared to be separable by reason of its longer pedicels, "snow white" rather than yellow or greenish yellow flowers and especially because of its narrower and more acuminate sepals.

A recently acquired Mexican collection (*Nagel & Juan G. 6447*), although it appears to be inseparable vegetatively from the Costa Rican *P. nana*, has long pedicels and sepals intermediate in form between those of typical *P. Broadwayi* and *P. nana*. It is further noted as having pale yellow-green flowers, as in *P. Broadwayi*. A Costa Rican collection (*Austin Smith H541*) also has pedicels of a length intermediate between the two concepts and flowers noted as pale lemon yellow as in *P. Broadwayi;* but it has sepals of quite the form of *P. nana*.

Therefore, in view of the great variability naturally to be expected of a wide ranging plant, it seems advisable to regard *P. Broadwayi* as representing one polymorphic species. It occurs in Mexico (Oaxaca), Honduras, Costa Rica (type of *P. nana*), Panama (type of *P. Williamsii*),

Cuba, Martinique, Guadeloupe (type of *P. guadalupensis*) and Venezuela (Island of Margarita).

Pleurothallis leucantha *Schlechter* in Fedde Repert. 10 (1912) 353.

Pleurothallis Sanchoi Ames in Sched. Orch. 4 (May 1923) 26.

Pleurothallis gonioglossa Schlechter in Fedde Repert. Beih. 19 (November 1923) 189.

Judging from the type description of the Guatemalan *Pleurothallis leucantha* (amplified by an analytical drawing made under the supervision of Dr. Schlechter), that species differs from the Costa Rican *P. Sanchoi* (represented by the type and several subsequent collections), by having generally longer and more acuminate leaves, smaller flowers, somewhat dissimilar straighter petals and an obtuse (not apiculate) lip.

In the Ames Herbarium there is a Guatemalan collection (*Harry Johnson 609*) taken to represent *P. leucantha* which came from the same region of Cobán as the type and at about the same altitude. This collection, which may be called a topotype of *P. leucantha*, has somewhat larger flowers than specified as typical, slightly curved petals and an apiculate lip which very nearly coincides with that of *P. Sanchoi*. Moreover, one Costa Rican collection (*Standley & Valerio 45983*) is entirely typical of *P. Sanchoi*, except that the petals are nearly straight, as in typical *P. leucantha*.

The concept described as *Pleurothallis gonioglossa*, which is represented by an isotype and analytical drawings in the Ames Herbarium, appears to be an exact vegetative counterpart of *P. Sanchoi*, although it has slightly larger flowers than the latter species. Except for inconsequential floral differences, this species appears to be inseparable from *P. leucantha*.

It seems logical, therefore, to regard *Pleurothallis leucantha* as a rather widespread and variable species in Central America.

Octomeria pygmaea *C. Schweinfurth sp. nov.*

Herba minutissima, epiphytica, corticicola. Caules perbreves, uniarticulati, vaginis duabus membranaceis tubulatis evanidis omnino obtecti. Folium anguste ellipticum, acutum, sessile, rigide nervosum, crasse marginatum. Inflorescentiae saepissime duae vel tres, abbreviatae, uniflorae. Flos membranaceus, perparvus sed pro planta magnus. Sepala persimilia, triangulari-lanceolata, acuta vel acuminata, trinervia, omnino libera. Petala lanceolata vel elliptico-lanceolata, acuta vel acuminata, uninervia. Labellum in circuitu rhombico-ovatum, medio profunde trilobatum; lobi laterales falcato-dolabriformes, porrecti; lobus medius obovato-oblongus, late obtusus, lobos laterales valde excedens. Columna in pedem subaequalem extensa.

Plant minute, caespitose, epiphytic in the cracks of the bark. Roots fibrous, relatively stout, glabrous. Stems numerous, clustered, abbreviated, about 4.8 mm. or less long, 1-jointed near the base, entirely concealed by two tubular scarious evanescent sheaths. Leaf solitary, sessile, narrowly elliptic, up to about 8 mm. long and 2.1 mm. wide, acute, conduplicate at the base, coarsely marginate, rigid-nervose, with the mid-nerve enlarged and prominent beneath. Inflorescences abbreviated, 1-flowered, apparently two or three to a stem. Flower very small, but large in relation to the plant, membranaceous. Sepals free, 3-nerved, concave. Dorsal sepal triangular-lanceolate, acute or acuminate, about 1.75 mm. long and 0.75 mm. wide. Lateral sepals very similar, but a little longer and wider, oblique. Petals lanceolate to elliptic-lanceolate, acute or acuminate, 1-nerved, about 1.5 mm.

long and 0.5 mm. wide. Lip rhombic-ovate in outline, deeply 3-lobed near the middle, cuneate at the base, about 1.1 mm. long and 0.87 mm. wide across the lateral lobes, with a pair of fleshy keels through the lower portion; lateral lobes falcate-dolabriform, subequal to the mid-lobe, obtuse, porrect, erect in natural position; mid-lobe obovate-oblong, broadly obtuse, much exceeding the lateral lobes. Column about half as long as the petals, produced into a subequally long foot. Pollinia eight, pyriform.

This species is probably the most minute member of the genus Octomeria yet described and ranks with the most insignificant orchids known to science. It appears to be allied to *O. minuta* Cogn., but differs in having acute sepals (when expanded), the lateral ones being free, as well as in having a widely dissimilar lip.

I take the liberty of quoting from the notes of the collector of this remarkable little orchid, as follows:

"After making camp one afternoon I put on the climbing irons in order to collect a specimen of a beautifully flowering *Cunuria crassipes*, a relative of Hevea rubber. When half way up the ninety foot tree, I stopped to lean back in the belt and rest. My glance was caught by what seemed to be a tiny orchid growing, together with the ever-present mosses and lichens, in the deep furrows of the shaggy dark brown bark of the tree. Carefully I plucked it out. Examination with a lens proved that it was indeed a very beautiful little orchid less than one half an inch high with yellowish flowers, of a genus unknown to me. Calling to Francisco to stop his cooking, I put the little plant in my note-book and let it fall to him. All other thoughts dismissed, we spent the rest of the afternoon searching the trunks of all the trees in the vicinity, but only a few additional specimens of the orchid were found.

"It is a coincidence that here occurred examples of the two extremes of the jungle plants which interest me most—the most diminutive of epiphytic orchids and the most gigantic of trees growing together, my interest in the latter leading to the discovery of the former."

BRAZIL: Upper Rio Negro drainage-area, Rio Dimití, at the base of Mt. Dimití, epiphytic in cracks of the bark of *Cunuria crassipes*, flowers yellow, May 12-19, 1948, *Richard Evans Schultes & Francisco Lopez 10003* (TYPE in Herb. Ames No. 65206).

Epidendrum flexuosissimum *C. Schweinfurth sp. nov.*

Herba parva, epiphytica, crassior. Rhizoma repens. Caules breves, robusti, approximati, vaginis tubulatis vel vaginarum fibris omnino tecti, apice bifoliati. Folia subopposita, late patentia, ovalia vel orbicularia, sessilia. Inflorescentia supra paniculata, laxe multiflora, cum pedunculo rachideque valde fractiflexa. Flores parvi, cum segmentis late patentibus. Sepalum dorsale elliptico-lanceolatum vel oblongo-lanceolatum, acuminatum. Sepala lateralia paulo majora, obliquissime elliptico-lanceolata, complicato-acuminata. Petala linearia, leviter sigmoidea, dense ciliata. Labellum columnae valde adnatum; lamina carnosa, medio trilobata; lobi laterales erecto-incurvi, aliformes; lobus medius triangularis, porrectus.

Plant small, rather stout, about 8–17 cm. high. Rhizome creeping (usually fragmentary in our specimens). Roots numerous, fibrous, glabrous, slender, commonly unbranched. Stems short, stout, suberect to lightly flexuous, approximate and spreading from the rhizome, 1- or 2-jointed, entirely concealed by two or three tubular imbricating sheaths or the fibres of sheaths, about 1–3 cm. long, 2-leaved at the apex. Leaves subopposite, widely spreading, oval to orbicular, sessile, apparently always rounded at the apex and sometimes with a small

mucro, coriaceous, about 1.5–3.6 cm. long, up to 2.5 cm. wide. Inflorescence divaricately paniculate, much surpassing the leaves, with the peduncle and rachis markedly fractiflex; peduncle 3–4.5 cm. long, complanate and narrowly bialate with two to four prominent spreading bracts which are conduplicate, broadly winged on the back and 1.2 cm. or less long. Bracts subtending the branches of the panicle similar but smaller. Panicle loosely several- to many-flowered, with spreading or recurved few-flowered branches. Flowers small, pale greenish yellow, with spreading segments. Dorsal sepal elliptic-lanceolate or oblong-lanceolate, acuminate or short-acuminate, 3-nerved, about 8 mm. long and 2.2–2.9 mm. wide, dorsally keeled toward the apex. Lateral sepals very obliquely elliptic-lanceolate, complicate-acuminate above, concave, 3-nerved, prominently keeled toward the apex, 8.1–8.4 mm. long measured along the posterior margin, about 3 mm. wide. Petals linear, lightly sigmoid, acuminate, 1-nerved, with the margins densely ciliate, about 7 mm. long and 1.1 mm. wide. Lip adnate to the column nearly to the apex; lamina fleshy, concave below, 3-lobed near the middle, cordate at the base, acute or acuminate at the tip, 4–5 mm. long in the center; lateral lobes erect-incurved, semiovate or aliform, with or without a free apex; mid-lobe about equally large with the lateral lobes, porrect, triangular or ovate-triangular. Column stout and dilated upward when seen from the side, subentire at the apex, about 4 mm. long at the back.

This little species does not appear to have any near allies.

PANAMA: Coclé, Cerro Pajita, hills north of El Valle, at 1100 meters altitude, October 27, 1946, *Paul H. Allen 3780* (TYPE in Herb. Ames No. 65445).

Epidendrum pajitense *C. Schweinfurth sp. nov.*

Herba elata. Caulis suberectus, gracilior, vaginis arctis

tubulatis pustulatis omnino velatus. Folia disticha, late patentia, superne solum praesentia, oblongo-lanceolata vel anguste elliptico-lanceolata. Inflorescentiae laterales et terminales, laxe pluriflorae. Florum segmenta valde patentia. Sepala elliptico-oblonga, lateralia obliqua. Petala cuneato-spathulata, subacuta. Labellum columnae valde adnatum; lamina trifida, cum lobis lateralibus oblique obovato-oblongis et lobo medio flabellato-cuneato, profunde bilobato. Columna apice quadrialata.

Plant rather tall, "saprophytic." Rhizome apparently abbreviated. Roots fibrous, numerous, rather stout, glabrous. Stem suberect, rather slender, with one strict flower-bearing branch above (the main stem broken off), entirely concealed by close tubular pustulose sheaths which are leaf-bearing above, about 49 cm. high. Leaves several to numerous, distichous, spreading, oblong-lanceolate or narrowly elliptic-lanceolate, obtuse to subacute, sessile at the shortly cuneate base, 3.5–6.2 cm. long, about 1.3 cm. or less wide, coriaceous. Inflorescences lateral and terminal; the lateral on the upper part of the stem, racemose, short, loosely few-flowered; the terminal one loosely paniculate with ascending few-flowered branches. Floral bracts minute, concave, ovate or oblong-ovate. Flowers medium-sized, rose-pink, with widely spreading more or less convex segments. Dorsal sepal oblong or elliptic-oblong, broadly obtuse to subacute, about 7-nerved, rather fleshy, about 9.3 mm. long and 3.9 mm. wide. Lateral sepals similar, obliquely elliptic-oblong, obtuse to subacute with a blunt dorsal mucro, about 10.5 mm. long, measured from the base of the dorsal margin to the tip, and 4 mm. wide, about 7-nerved. Petals cuneate-spatulate, abruptly rounded above with a subacute apex, 3-nerved with the lateral nerves branching, slightly oblique, about 10 mm. long and 3.2 mm. wide above. Lip adnate to the column up

to the tip; lamina 3-parted, much exceeding the sepals, submembranaceous; lateral lobes widely spreading, obliquely obovate-oblong, with a more or less truncate and obscurely lobulate outer margin, separated by a pair of small complanate calli, about 7.5 mm. long through the middle lengthwise and 3.9 mm. wide above; mid-lobe porrect, narrowly flabellate-cuneate, conspicuously bilobed with a minute blunt apicule between the oblong-rounded lobules and with a small callus at the base between the lateral calli, about 8.2 mm. long to the tip of an apical lobule and 7.2 mm. wide across the apical lobules. Column short, very stout and dilated upward when viewed from the side, about 6.5 mm. long at the back including the erect 4-lobed wing, with the middle lobes oblong-subquadrate and irregularly lobulate on the truncate apex.

This species has three rather close allies. *Epidendrum exasperatum* Reichb.f. differs in having smooth cauline sheaths, verrucose outer surfaces of the sepals and flowers of another color. *E. Schumannianum* Schltr. has broader leaves, broader petals, relatively smaller lateral lobes of the lip and spotted flowers. *E. verrucosum* Sw. var. *myrianthum* (Lindl.) Ames & Correll shows much narrower and relatively longer leaves and a lip with dissimilar details.

PANAMA: Coclé, Cerro Pajita, hills north of El Valle, at 1100 meters altitude, October 27, 1946, "saprophytic," in dense shade, *Paul H. Allen 3784* (TYPE in Herb. Ames No. 65444).

Epidendrum strictiforme *C. Schweinfurth sp. nov.*

Herba mediocris, epiphytica, recta. Rhizoma abest. Caulis in siccitate crassus, foliorum vaginis ancipitibus omnino vestitus. Folia disticha, quinque ut videtur, ovata vel oblongo-ovata, apice rotundata, basi lata amplexicaulia. Inflorescentia erecta; pedunculus spathis conduplicatis, erectis, imbricatis, duabus vel tribus omnino

obtectus; racemus dense multiflorus. Flores parvi. Sepalum dorsale oblanceolatum, acutum. Sepala lateralia oblique oblongo-oblanceolata, acuta vel breviter acuminata. Petala oblanceolato-linearia, leviter incurva, acuta vel breviter acuminata. Labellum columnae valde adnatum; lamina trilobata, carnosa; lobi laterales rotundato-dolabriformes, extus irregulariter crenulati; lobus medius ovatus, acutus. Columna generis, recta.

Plant medium-sized for the genus, stout, epiphytic, up to 37 cm. tall. Roots and rhizome not present. Stem apparently stout, entirely concealed by strongly complanate tubular leaf-sheaths. Leaves five, loosely distichous, ovate or oblong-ovate, rounded and minutely bilobed at the apex, amplexicaul at the broad base, about 5–7.5 cm. long, 2.8–3.4 cm. wide, spreading. Inflorescence erect, racemose above; peduncle apparently about 11 cm. long, entirely concealed by two or three strictly erect, conduplicate, imbricating spathes which are rounded to acute above; raceme densely many-flowered; floral bracts lax, linear-lanceolate, the lower ones about equaling the slender pedicellate ovary. Flowers small, pale brownish green flushed with purple, spreading. Dorsal sepal oblanceolate or elliptic-oblanceolate, acute, 5-nerved, about 9–10 mm. long and 3–3.4 mm. wide above. Lateral sepals obliquely oblong-oblanceolate, lightly sigmoid, acute or short-acuminate, longitudinally concave, 5-nerved, about 10.3–11 mm. long on the posterior margin and 3–3.3 mm. wide just above the middle. Petals oblanceolate-linear, lightly incurved, acute or short-acuminate, 1-nerved, about as long as the dorsal sepal and 1 mm. wide above. Lip adnate to the column up to its apex; lamina sharply 3-lobed, fleshy, cordate at the base, about 5–5.8 mm. long in the center and 6.4–7.7 mm. wide across the lateral lobes; lateral lobes rounded-dolabriform, with irregularly crenate outer mar-

gins; mid-lobe ovate, acute, protuberant, very fleshy, about 3–3.5 mm. long and 2.5–2.9 mm. wide at the base; disc with a pair of small fleshy conical calli at the base. Column straight, dilated above in front, retuse in the center at the summit, about 6.5–7 mm. long on the dorsal surface, produced on each side into an obliquely semiorbicular-ovate lobe.

This species apparently lacks any close allies. It may be related to *Epidendrum sarcodes* Lindl., but differs in having the peduncle entirely concealed by the spathes, and in having acute sepals, etc.

Peru: Huánuco, Carpish, at 2800 meters altitude, on a tree in cloud forest, leaf not thick but very hard and stiff, tip of column white, September 1946, *F. Woytkowski 37014* (Type in Herb. Ames No. 65451).

Brassavola ovaliformis *C. Schweinfurth sp. nov.*

Herba epiphytica, pro genere mediocris, deserticola. Rhizoma repens, nodulosum. Caules approximati, plus-minusve elongati, vaginis tubulatis imbricatis scariosis omnino obtecti. Folia subteretia, gracilia, elongata, in siccitate arcuata. Flores duo, grandes, in pedunculi apice approximati. Sepala petalaque late patentia, valde similia, lanceolato-linearia, sensim angustata, apice acuta. Labellum multo brevius, inferne leviter involutum, expansum ovale-ovatum, acutum, ecarinatum, margine integro. Columna perbrevis, apice trialata, cum alis lateralibus falcato-lanceolatis et recurvis.

Plant epiphytic. Roots fibrous, covered with a stout glabrous velamen. Rhizome creeping, nodulose, consisting of the approximate swollen bases of the stems. Stems crowded, up to 12.7 cm. or more long (the longest one incomplete), several-jointed, entirely enveloped by long tubular scarious imbricating sheaths, gradually dilated upward, 1-leaved at the apex. Leaves very slender, subterete, channelled, arcuate in the dried specimen, about

27.2–38.2 cm. or more long (the longest blade incomplete), apparently about 3 mm. in diameter. Peduncle exceeding 2.5 cm. in length (incomplete), with two flowers at the apex. Floral bracts very small, lanceolate-ovate, acuminate, deeply concave, amplexicaul, much shorter than the pedicellate ovary which is about 4 cm. long. Flowers large with widely spreading segments. Dorsal sepal lanceolate-linear, long-narrowed to an acute tip, about 5.3–5.8 cm. long and 5.5 mm. wide near the base. Lateral sepals closely similar, about 5.9 cm. long and 5 mm. wide below. Petals similar to the sepals, linear-lanceolate, about 5–5.3 cm. long and 5.4 mm. wide below. Lip much shorter than the other segments, oval-ovate or lanceolate-oval in outline when expanded, about 4.7–4.9 cm. long and 2.9 cm. wide across the middle, acute, ecarinate, with the lower half gradually inrolled in natural position, the margins being entire. Column minute, with an erect 3-lobed wing at the apex, about 6.5 mm. high at the back; lateral wings falcate-lanceolate and recurved; middle wing low and irregular, abruptly extended in the center into a ligulate, apically truncate and denticulate projection; anther oblong-ellipsoid, 2-celled, with four narrowly oblong-ellipsoid pollinia in each cell.

This species appears to have no near allies. In the whiteness of the flowers and in the apex of the column it resembles the widespread *Brassavola nodosa* (L.) Lindl., but it lacks the elongated narrow serrated basal portion of the lip of that species. *B. Perrinii* Lindl., from Brazil, differs in having smaller green flowers, a somewhat carinate lip and dissimilar column-wings.

PERU: Amazonas, La Peca, northeast of Jaen, at 1000 meters altitude, on dwarf trees in dry "desert forest full of cacti," flower uniformly white, the lip having a median greenish yellow line above and beneath, "interior parts . . . pale green save the whitish column and the two formations immediately below, which are whitish with a brown

hue, leaves dark green, tapering, stiff, round like thick wire," November 18, 1947, *F. Woytkowski 37016* (TYPE in Herb. Univ. Calif.).

Odontoglossum angustatum *Lindley* in Bot. Reg. 23 (1837) sub t. 1992; Fol. Orch. Odontoglossum (1852) 17, no. 48, non *O. angustatum* Lindley Orch. Linden. (1846) 17, no. 90; Bateman Monog. Odontog. (1874) t. 26.

Odontoglossum tetraplasium Reichenbach filius in Gard. Chron. n.s. 3 (1875) 558.

Odontoglossum bellum Schlechter in Fedde Repert. Beih. 9 (1921) 108; ex Mansfeld in Fedde Repert. Beih. 57 (1929) t. 127, nr. 499.

Odontoglossum Loesenerianum Schlechter in Fedde Repert. Beih. 9 (1921) 110; ex Mansfeld in Fedde Repert. Beih. 57 (1929) t. 128, nr. 502.

A sketch of the panicle with a drawing of a solitary flower (natural size) and a single enlarged lip of *Odontoglossum tetraplasium* from the Reichenbach Herbarium shows that this concept cannot reasonably be separated from *O. angustatum* Lindl. (1837), as represented by a photograph of the type specimen from the Lindley Herbarium bearing a pen drawing of the callus on the lip. The vegetative parts were lacking in the type specimens of both species, but these were supplied for *O. angustatum* by a subsequent collection mounted with the Lindley type.

Judging from the description and floral analysis, *Odontoglossum bellum* is also a form of this variable species. *O. bellum* appears to be quite as large throughout as typical *O. angustatum*, but the sepals are not so elongate-acuminate as in many forms of the latter. The lip which is described and shown as obtuse and apiculate, is not very dissimilar to the acute lip of *Vargas 2888* and *Vargas 3664* which have been determined as *O. angustatum*.

The floral analysis of *Odontoglossum Loesenerianum* indicates that this concept is surely referable to *O. angustatum* as first described by Lindley, the only apparent discrepancies being that the bracts are noted as being equal to or a little exceeding the ovary (they are about half as long in *O. angustatum*) and the flowers are described as somewhat smaller. This difference in size is probably due to an immature condition.

In the several collections here referred to *O. angustatum*, there appears to be a wide variation both in vegetative and floral size and in the form of the lip. The most striking variations from the usual form are seen in *Vargas 2888*, where the obviously immature flowers are smaller than those of *O. Loesenerianum* and have a lip which is more or less lightly pandurate; and in *Weberbauer 7797*, where the carinate calli at the base of the lip are broader, blunter and thicker than in the usual form. All of the Peruvian collections included in this species, however, have a general similarity of lip calli, but there is apparently lacking from all of them one extra pair of tubercles present in the type.

It seems to me, therefore, that *Odontoglossum angustatum* is a conspicuous example of the polymorphism that makes the tropical orchids so difficult.

Odontoglossum aureo-purpureum (as auropurpureum) *Reichenbach filius* in Linnaea 22 (1849) 848; Lindley Fol. Orch. Odontoglossum (1852) 15, no. 44.

Odontoglossum compactum Reichenbach filius in Gard. Chron. n.s. 3 (1875) 492.

Odontoglossum Kochleri Schlechter in Fedde Repert. Beih. 9 (1921) 109; ex Mansfeld in Fedde Repert. Beih. 57 (1929) t. 128, nr. 501.

The concept *Odontoglossum compactum* is based in part on Peruvian specimens collected by W. Lobb which

were formerly referred by Lindley (Fol. Orch. Odontoglossum p. 15) to *O. aureo-purpureum*. It was separated from the earlier species by its more compact densely flowered panicles of larger flowers. However, two recent Peruvian collections (*Vargas 2879* and *Metcalf 30742*) have the loose panicles seen in the typical Venezuelan *O. aureo-purpureum*, but they have larger flowers than those of the type which they appear to match in floral details.

Odontoglossum Kochleri is described as having a rather densely flowered panicle, like *O. compactum;* but its floral segments, except for being slightly broader, coincide well with those of typical *O. aureo-purpureum*.

It seems to me, therefore, that *O. aureo-purpureum* is a widely variable species which includes the above concepts.

Odontoglossum brevifolium *Lindl.* var. **Weberbauerianum** (*Kränzl.*) *C. Schweinfurth comb. nov.*

Oncidium Weberbauerianum Kränzlin in Engler Bot. Jahrb. 37 (1906) 389.

Cyrtochilum Weberbauerianum Kränzlin in Notizbl. Bot. Gart. Berlin 7 (1917) 95, *nomen nudum, in clavi;* in Engler Pflanzenreich IV. 50, pt. 2 (Heft 80) (1922) 60, fig. 5H, a–c.

Odontoglossum Weberbauerianum Schlechter in Fedde Repert. Beih. 27 (1924) 109.

In Fedde Repert. Beih. 9 (1921) 170, Dr. Schlechter cites *Oncidium Weberbauerianum* as a synonym of the well-known *Odontoglossum brevifolium* Lindl.

I have not seen any figure of *Oncidium Weberbauerianum*, but, after examining an iso-type collection of *Odontoglossum brevifolium*, there appear to be several marked differences between that species and the description of *Cyrtochilum Weberbauerianum* (supplemented by

a floral analysis). It seems to me, therefore, that the above varietal designation is preferable, for the reasons indicated in the following table of comparisons.

Odontoglossum brevifolium	*Oncidium Weberbauerianum*
Pseubobulbs ovoid to cylindric-ovoid, up to 5 cm. long.	Pseudobulbs "linear," up to 10 cm. long.
Leaves oval to oblong-elliptic, up to 15 cm. long and 7.6 cm. wide.	Leaves oblong, up to 20 cm. long and 4.5 cm. wide.
Sepals suborbicular to round-obovate, little longer than broad.	Sepals oblong, much longer than broad.
Lip deeply bilobed at the apex.	Lip obscurely lobulate in front.

Odontoglossum flavescens *Rolfe* in Orch. Rev. 12 (1904) 92.

This species was too inadequately described to furnish a definite concept that can be visualized or keyed. The description, which gives no hint of vegetative parts, merely states that the flowers are clear yellow, that the segments are elliptical-oblong and subconnivent, while the blade of the lip is suberect, rounded below, with an oblong obtuse apex and has a very large 2-lobed callus appressed to the base of the column. It is noted as being allied to *O. retusum* Lindl., and was introduced by Messrs. F. Sander & Co., presumably from Ecuador and Peru.

A photograph of the type specimen in the Herbarium at Kew shows fragments of an elliptical-oblong pseudobulb which is about 8.5 cm. long and appears to be bifoliate or trifoliate. The single leaf shown is oblong-linear, short-acuminate, slightly narrowed to a sessile base, over 51 cm. long and about 2.4 cm. wide, with the mid-nerve very prominent beneath. The inflorescence shows a very loosely branched panicle with two horizontally spreading branches. The flowers are distant, secund, on long pedicels (up to 2 cm. long) much exceeding the minute bracts, and the segments appear to be about 1 cm. long.

Even with this additional information, however, it seems advisable to consider this concept among the obscure species.

Odontoglossum mystacinum (*Lindl.*) *Lindley* Fol. Orch. Odontoglossum (1852) 6, no. 14.

Cyrtochilum mystacinum Lindley in Bot. Reg. 24 (1838) Misc. 30, no. 38; in Bot. Reg. 25 (1839) t. 62.

Odontoglossum rigidum Lindley in Benth. Pl. Hartw. (1844) 152; Fol. Orch. Odontoglossum (1852) 7, no. 17.

Judging by an excellent photograph of the type of *Odontoglossum rigidum* from the Lindley Herbarium, this concept cannot reasonably be separated from the species depicted as *Cyrtochilum mystacinum* in the Botanical Register 25, t. 62. A slight difference is that the pseudobulb of the latter concept is represented as unifoliate, whereas that of *O. rigidum* is bifoliate with very unequal leaves. Recent Peruvian collections which are referable to this concept have sometimes unifoliate and sometimes bifoliate pseudobulbs. Although *O. rigidum* has a more branched and fractiflex panicle than that of *Cyrtochilum mystacinum*, the plate was obviously drawn from an immature specimen. A minor difference is that the wings of the column in the latter concept are rather broad and multifid, whereas they are drawn as rather narrow and serrate in *O. rigidum*.

Both species, however, have similar pseudobulbs and yellow flowers with almost identical segments. The sepals are lanceolate, the petals ovate-lanceolate and the lip pandurate-obovate. Moreover, the column wings are not easily seen in the specimens examined and appear to be variable.

This species appears to be limited to Peru, Ecuador, and perhaps Bolivia.

Odontoglossum obscurum *C. Schweinfurth nom. nov.*

Mesospinidium Wallisii Reichenbach filius in Linnaea 41 (1876) 106, non *Odontoglossum Wallisii* Linden & Reichb.f. (1870).

As illustrated by a series of floral analyses from the Reichenbach Herbarium, *Mesospinidium Wallisii* has the basal part of the lip parallel to the column with the anterior half abruptly reflexed. It seems, therefore, to be clearly referable to the genus *Odontoglossum*.

Since the specific epithet, *Wallisii*, has already been used under *Odontoglossum*, the new name *obscurum* is proposed, in allusion to the fact that the pseudobulb and leaves were unknown when the species was described.

Except for the lip, which is described and illustrated as retuse at the apex and emarginate in the middle [of each side], this concept might reasonably be referred to *Odontoglossum longifolium* Lindl.

Odontoglossum Wyattianum *G. Wilson* in Orch. Rev. 36 (1928) 47.

In the diagnosis of this species there is no description of the vegetative parts of the plant nor of the inflorescence. With regard to the flowers, only the size and color are noted; there is no mention of the exact shape of the parts. Finally, the precise origin of the species is doubtful, for the description merely states that "the plant had been obtained from the Rev. Paul Wyatt, Bedford, to whom it had been forwarded by a friend in Peru, doubtless its native country."

It seems advisable, at the present time, to relegate this concept to the class of obscure species.

Oncidium falcipetalum *Lindley* Orch. Linden. (1846) 14, no. 76: Fol. Orch. Oncidium (1855) 5, no. 7:

Cogniaux Dict. Icon. des Orch. Oncidium (1899) t. 21.

Oncidium Pavonii Reichenbach filius ex Lindley Fol. Orch. Oncidium (1855) 5, sub no. 7, *nomen nudum;* Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 38.

Oncidium ionodon Reichenbach filius in Linnaea 41 (1876) 23.

Oncidium Davisii Reichenbach filius in Linnaea 41 (1876) 24.

Cyrtochilum falcipetalum Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 37, fig. 1 G, a–c.

Cyrtochilum Pavonii Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 38.

Oncidium Pavonii, although lacking any original diagnosis, has been considered by the several writers mentioning the name as a form of *O. falcipetalum.*

Judging from the description (limited to the flower), the Peruvian *Oncidium ionodon* differs from *O. falcipetalum* only in having an emarginate dorsal sepal, clawed petals and porrect violet lateral lobes of the lip. However, the plate of *O. falcipetalum* illustrated in Cogniaux' work (l.c.) shows a crisped dorsal sepal, which might well be taken for emarginate, and petals that appear to be more or less clawed. Also, in specimens reasonably referred to *O. falcipetalum*, the petals (when examined closely) are very shortly clawed. In general, too, the color of the flower attributed to *O. ionodon* coincides with that shown in the plate indicated.

Oncidium Davisii, of which there is in the Ames Herbarium a tracing of the floral analysis from the Reichenbach Herbarium, is almost an exact counterpart of *O. ionodon*, except that the dorsal sepal is noted as acute, the petals as very shortly clawed, and the lateral lobes of the lip deflexed.

It is a strange coincidence that both *O. ionodon* and

O. Davisii are cited as synonyms of one species, *Cyrtochilum monachicum*, by Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 47. However, the latter concept, based upon *Oncidium monachicum* Reichb.f., is described as having the dorsal sepal reniform, and thus is quite dissimilar to that of *O. falcipetalum* or its forms.

Apparently *Oncidium falcipetalum* is a variable species as regards floral size and the contour of the petals which varies from flat to conduplicate.

Originating in Venezuela (Merida), this species is also recorded from Colombia and Peru.

Oncidium heteranthum *Poeppig & Endlicher* Nov. Gen. ac Sp. 1 (1836) 34, t. 60; Cogniaux in Martius Fl. Bras. 3, pt. 6 (1905) 378, t. 87; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 175.

Oncidium bryolophotum Reichenbach filius in Gard. Chron. (1871) 738; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 181.

Oncidium inops Cogniaux & Rolfe in Journ. des Orch. 3 (1893) 346; 4 (1893) 74.

Oncidium megalous Schlechter in Fedde Repert. 9 (1911) 30.

The above species is extremely variable. This fact has led to the proposal of several later concepts, none of which, however, seems valid.

Oncidium bryolophotum, a native of Costa Rica and Panama, and represented in the Ames Herbarium by Reichenbach's detailed analyses, by authentic material examined by Kränzlin, and by many Central American collections, cannot logically be separated from the earlier *O. heteranthum* from Colombia, Peru and Bolivia.

In general, the Central American plants referred to *O. bryolophotum* have a mid-lobe of the lip which is relatively larger than that of *O. heteranthum*, but one Costa

Rican collection (*Standley 33741*) has a lip which is quite similar to that of the South American *O. heteranthum*.

One Peruvian collection of *O. heteranthum* (*Vargas 2531*) varies from the usual form in lacking the separate calli on the lateral (or basal) lobes of the lip and in having the apex of the column-wings narrowed to an acuminate point rather than having the typical more or less broad apex. Another Peruvian collection (*Schunke s.n.*, Herb. Field Mus. No. 571665) has a row of detached calli extending onto the lateral lobes on each side of the middle callus.

Other differences noted in the various collections appear in the vegetative size, in the oblong-ovoid to cylindric pseudobulbs, and in the leaves which vary from linear-oblong to elliptic.

The other concepts cited above have already been reduced to the synonymy of *O. bryolophotum*.

Oncidium incarum (*Kränzl.*) *C. Schweinfurth comb. nov.*

Cyrtochilum Incarum Kränzlin in Engler Pflanzenr. IV. 50, pf. 2 (Heft 80) (1922) 58.

Since it seems unwise to regard the concept *Cyrtochilum* as distinct from the large and variable genus *Oncidium*, the above transfer is necessary.

Oncidium macranthum *Lindley* var. **hastiferum** (*Reichb.f. & Warsc.*) *C. Schweinfurth comb. nov.*

Oncidium hastiferum Reichenbach filius & Warscewicz in Bonpl. 2 (1854) 102; Reichenbach filius in Walp. Ann. 6 (1863) 703.

Cyrtochilum hastiferum Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 34.

Judging by the descriptions of *Oncidium hastiferum* and by a drawing in the Reichenbach Herbarium, made from cultivated material, it appears preferable to con-

sider this concept as a variant of the widespread *O. macranthum*. It seems to differ from *O. macranthum* only in having one large median keel flanked by a smaller lamella on each side (instead of three equal lamellae) and in having narrower ligulate wings on the column.

Oncidium obryzatum *Reichenbach filius & Warscewicz* in Bonpl. 2 (1854) 108; Regel in Gartenfl. 27 (1878) t. 925; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 239, fig. 20 B, a–d.

The Peruvian collection cited below shows several discrepancies from typical examples of *O. obryzatum* in the Ames Herbarium.

The pseudobulb is bifoliate, not unifoliate as described. The leaves are longer than exemplified, being up to 52.5 cm. long. The branches of the peduncle appear to be rather more distant than otherwise shown, being about 5–6.5 cm. (instead of 2–4 cm.) apart. The sepals and petals, although closely similar to those of the typical form, are somewhat abruptly acute, rather than obtuse or rounded or even retuse. The narrow middle part of the lip is somewhat broader than usual and the anterior portion or middle lobe is narrower relative to the basal portion. The column wings are merely acute, not acuminate, above.

In view of the general agreement of this specimen with the typical form, however, this collection is incorporated with *O. obryzatum*.

Peru: Cajamarca, Cutervo, about Socota, on Socota River, at 2800 meters altitude, epiphyte, December 11, 1938, *H. E. Stork & O. B. Horton 10152*.

Oncidium pyramidale *Lindley* in Ann. & Mag. Nat. Hist. 15 (1845) 384; Fol. Orch. Oncidium (1855) 29, no. 98; Veitch Man. Orch. Pl., pt. 8 (1892) Oncidium 73; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 195, fig. 16 J, a–c.

Oncidium chrysopyramis Reichenbach filius & Warscewicz in Bonpl. 2 (1854) 108; Lindley Fol. Orch. Oncidium (1855) 29, no. 97; Veitch Man. Orch. Pl., pt. 8 (1892) Oncidium 25; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 196, fig. 16 F, a–d.

Judging from drawings of the habit and floral analyses of *Oncidium chrysopyramis* from the Reichenbach Herbarium, supplemented by the descriptions, it does not seem reasonable to separate this concept from the earlier *O. pyramidale*. The latter species appears to differ from *O. chrysopyramis* in having a longer panicle with the lower branches often compound and many-flowered, not simple and 3- to 5-flowered—a character which is variable and therefore unimportant as a basis for specific separation.

The basal portion of the lip is described as being broader than the anterior portion in both species, contrary to remarks made by Reichenbach following his description of *O. chrysopyramis*.

Again, the wings of the column, a character which was considered of great consequence in separating the concepts, appear to be highly variable in Reichenbach's own figures. Indeed, the column-wings shown in the pen drawing on the type collection of *O. pyramidale* appear to be a close approximation to some of those depicted by Reichenbach for *O. chrysopyramis*.

Oncidium superbiens *Reichenbach filius* in Linnaea 22 (1849) 843; Hooker filius in Bot. Mag. 98 (1872) t. 5980; Warner & Williams Orch. Alb. 6 (1887) t. 276.

Oncidium aemulum Reichenbach filius & Warscewicz in Bonpl. 2 (1854) 102.

Oncidium inferlobum hort. ex Gard. Chron. (1872) 904, *in synon.*

Oncidium undulatum Warner & Williams Orch. Alb.

8 (1889) t. 368, non *O. undulatum* (HBK.) Lindl. (1842).
Cyrtochilum aemulum Kränzlin in Notizbl. Bot. Gart. Berlin 7 (1917) 93, *nomen nudum, in clavi;* in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 47, fig. 3 C, a–e.
Cyrtochilum superbiens Kränzlin in Notizbl. Bot. Gart. Berlin 7 (1917) 93, *nomen nudum, in clavi;* in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 49, fig. 3 E, a–f.

After a careful comparison between *Oncidium superbiens* (represented by a photograph of the type and the type description) and *O. aemulum* (represented by a photograph of Lindley's concept, supplemented by the type description), I am unable to separate the two species.

All the specimens of *O. superbiens* noted appear to have the petals yellowish or whitish, more or less barred below with brown or purplish brown, whereas there is no record of such coloring in *O. aemulum*.

The figures of these concepts in the Pflanzenreich (under Cyrtochilum) confirm my conclusions that they are conspecific.

Oncidium ventilabrum *Reichenbach filius & Warscewicz* in Bonpl. 2 (1854) 101; Lindley Fol. Orch. Oncidium (1855) 6, no. 12.
Cyrtochilum undulatum Humboldt, Bonpland & Kunth Nov. Gen. et Sp. Pl. 1 (1816) 349, t. 84; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 57.
Oncidium undulatum Lindley Sert. Orch. (1842) sub t. 48, no. 1; Reichenbach filius & Warscewicz in Bonpl. 2 (1854) 108; Lindley Fol. Orch. Oncidium (1855) 7, no. 15, nec *Oncidium undulatum* Sims (1804) nec *O. undulatum* Salisb. (1812).
Cyrtochilum ventilabrum Kränzlin in Notizbl. Bot.

Gart. Berlin 7 (1917) 92, *nomen nudum, in clavi;* in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 39, fig. 2 C, a–c.

In his original description of *Oncidium ventilabrum* Reichenbach admitted that this species was close to *O. undulatum* Lindl., but he adduced several supposedly weighty reasons for separating them. Among other features he said, "Zunächst hat unsre Art zweimal so grosse Blüthen, die seitlichen Sepala breiter, das obere länger. Der mit dem Fuss der Säule verwachsene Lippennagel is viel länger. . . ."

In the Ames Herbarium there are several records of *Oncidium ventilabrum* (a drawing of a flowering branch and numerous floral analyses) from the Reichenbach Herbarium, and these show a rather striking agreement both in size and form of sepals and petals with those shown in the plate of the type of *Cyrtochilum undulatum* (l.c.). Moreover, the lip is depicted as sessile in both concepts. The form of the lip and the calli at the base of the lamina are supposed to be different in the two species, but in the drawings of *O. ventilabrum* there is a rather wide range in these features. Furthermore, in the remarks about *O. undulatum* (in Bonpl. 2, p. 108) Reichenbach described a lip-callus which is rather similar to that shown in *O. ventilabrum.*

It appears to be the wise procedure to eliminate the necessity of straining for supposed differences between these two concepts and to consider them conspecific.

However, since there is an earlier and different *Oncidium undulatum*, it is necessary to reject this specific epithet and to adopt the next earlier name, *Oncidium ventilabrum.*

Sigmatostalix *Reichenbach filius* in Bot. Zeit. 10 (1852) 769; Schlechter in Fedde Repert. 15 (1918) 139;

Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 301.

Petalocentrum Schlechter in Fedde Repert. 15 (1918) 144; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 312.

The concept *Petalocentrum* was separated from the variable genus *Sigmatostalix* by reason of three alleged differences (Cf. Schlechter in Fedde Repert. 15 (1918) 145), viz. the sessile lip, the spur-like outgrowth at the base of the petals and the ascending rostellum.

The characterization of the lip in the type description of *Sigmatostalix* (l.c), to be sure, specifies "labellum unguiculatum." However, the lip in the typical species, *S. graminea* (as *Specklinia graminea* Poepp. & Endl. in Nov. Gen. ac Sp. 1 (1836) 51, t. 89 B), appears to be cuneate below to a sessile base; and, even if the analysis is discarded as being inadequate (on the basis of later representations), that organ seems to be at most only very shortly unguiculate.

At any rate, some species which were described as belonging to *Sigmatostalix*, such as the Central American *S. hymenantha* Schltr., have the basal part of the lip more or less cuneate to a sessile base (apparently very broadly cuneate). And other species, such as *S. macrobulbon* Kränzl., have an absolutely sessile lip. In the face of such wide variation, therefore, it seems advisable to discard this character, at least as to its generic value.

As regards the spur-like outgrowth on the petals, this character appears to be quite absent in some species with a strikingly sessile lip which were referred to *Sigmatostalix*, such as *S. macrobulbon* Kränzl. Nor does this character appear in *S. hymenantha* Schltr. with the broadly cuneate base to the lip. It would seem, therefore, that this outgrowth on the petals, seen in one poly-

morphic species of this alliance, is scarcely of generic weight when taken alone.

Finally, the factor of an ascending rostellum appears to be a matter of degree, even if not too recondite and obscure for ordinary recognition in the dried specimen.

It appears to me that the wise course is to relegate *Petalocentrum* to the synonymy of the variable genus *Sigmatostalix*.

The concept, *Petalocentrum angustifolium*, the only one of the genus not previously described as representing *Sigmatostalix*, was considered identical with *Sigmatostalix pusilla* Schltr. (cf. Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 312), and the generic identity of the concepts *Petalocentrum* and *Sigmatostalix* was once suspected by Kränzlin (cf. l.c. 313).

Sigmatostalix peruviana *Rolfe* in Kew Bull. (1910) 371.

Sigmatostalix pusilla Schlechter in Fedde Repert. 10 (1912) 392.

Sigmatostalix bicornuta Rolfe in Kew Bull. (1913) 342.

Petalocentrum pusillum Schlechter in Fedde Repert. 15 (1918) 145; Kränzlin in Engler Pflanzenr. IV. 50, pt. 2 (Heft 80) (1922) 312; ex Mansfeld in Fedde Repert. Beih. 58 (1930) t. 59, nr. 235.

Petalocentrum angustifolium Schlechter in Fedde Repert. 15 (1918) 145; ex Mansfeld in Fedde Repert. Beih. 58 (1930) t. 59, nr. 234.

Petalocentrum bicornutum Schlechter in Fedde Repert. Beih. 9 (1921) 179.

All of the concepts cited above appear to be closely similar vegetatively, although *Sigmatostalix pusilla* is described as having markedly shorter pseudobulbs and leaves than the others. It is significant that the sepals and petals of all of the concepts are of almost exactly the

same form and size, the only discrepancy being in the degree of acuteness of the apex. In *S. peruviana* there is no mention of a horn at the base of the petals (which occurs in all of the others), but this species seems surely identical with *S. bicornuta*, even the color of the flowers being nearly identical. The lip seems to vary somewhat in size in the various species, but it appears to be of very similar form throughout. A rather wide diversity is described in the callus on the lip in the various concepts, but it is noteworthy that this feature appears to be often very variable in a single species of *Sigmatostalix*.

Since, without actual specimens, it would be extremely difficult to recognize differences between these species, the wise course suggests their union.

Ornithocephalus gladiatus *Hook.* var. **peruvianus** *C. Schweinfurth var. nov.*

Planta scapis brevioribus folia non valde excedentibus, sepalorum mucronibus valde prominentibus, sepalo dorsali quam sepalis lateralibus majore, ac praesertim labelli callo margines basales solum paulo superanti a specie differt.

Plant small, with the general appearance of *Ornithocephalus gladiatus* Hook., but differing in having scapes shorter than or subequaling (not markedly exceeding) the leaves, in having a very conspicuous mucro on the sepals, in having the dorsal sepal somewhat larger than the lateral sepals, and particularly in having a less prominent and spreading basal callus on the lip which but slightly exceeds the margins.

PERU: Junín, La Merced, at about 610 meters altitude, in montaña, on tree trunk, flowers white with green markings, August 10–24, 1923, *J. Francis Macbride 5480* (TYPE in Herb. Field Mus. No. 536520).

ILLUSTRATIONS

EXPLANATION OF THE ILLUSTRATION

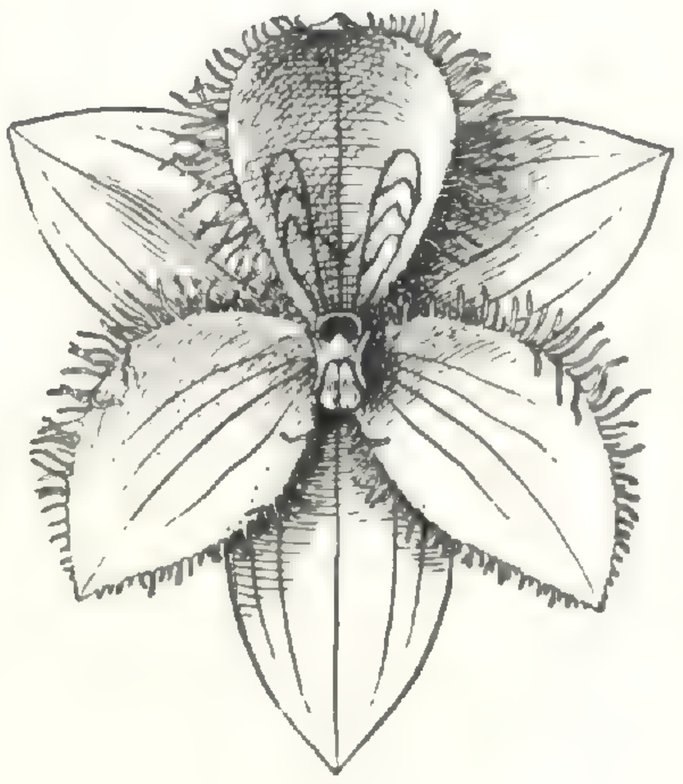
PLATE XII. CRANICHIS CILIILABIA *C. Schweinfurth.* 1, plant, natural size. 2, flower expanded, from the front, four times natural size. 3, half of the lip, cut longitudinally, from the side, seven times natural size.

Drawn by E. W. SMITH

CRANICHIS

ciliilabia

C. Schweinf.



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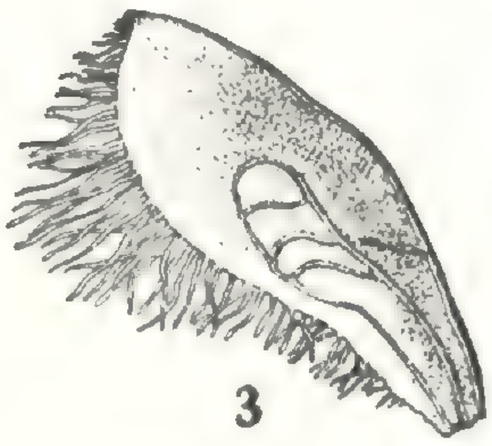
1



3

E. W. Smith

EXPLANATION OF THE ILLUSTRATION

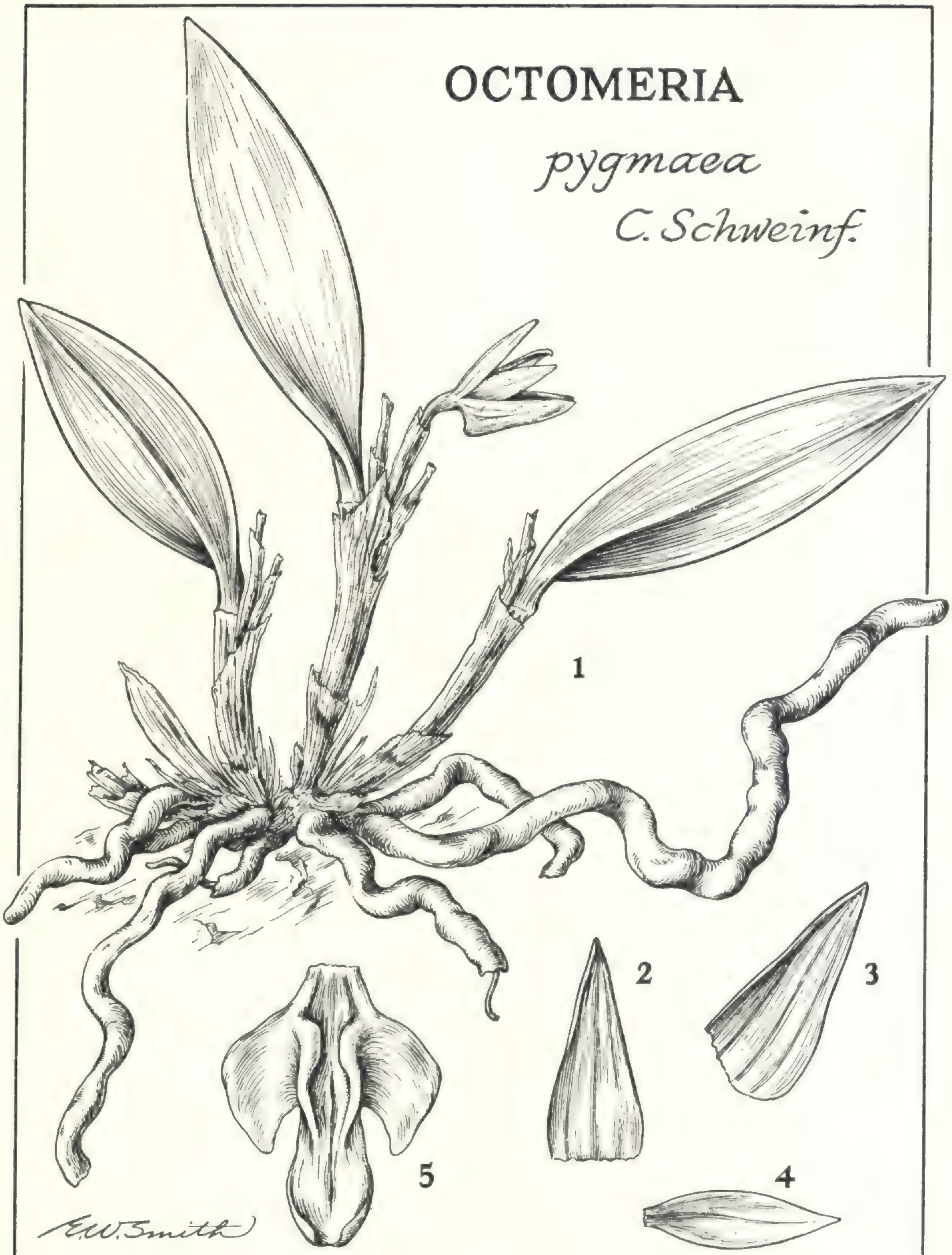
PLATE XIII. OCTOMERIA PYGMAEA *C. Schweinfurth.* 1, plant, eight times natural size. 2, dorsal sepal, sixteen times natural size. 3, lateral sepal, sixteen times natural size. 4, petal, sixteen times natural size. 5, lip expanded, from above, thirty-two times natural size.

Drawn by E. W. SMITH

OCTOMERIA

pygmaea

C. Schweinf.



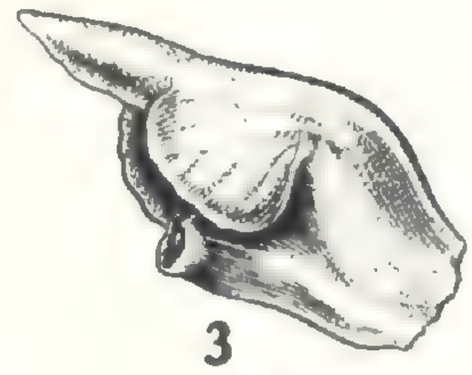
E. W. Smith

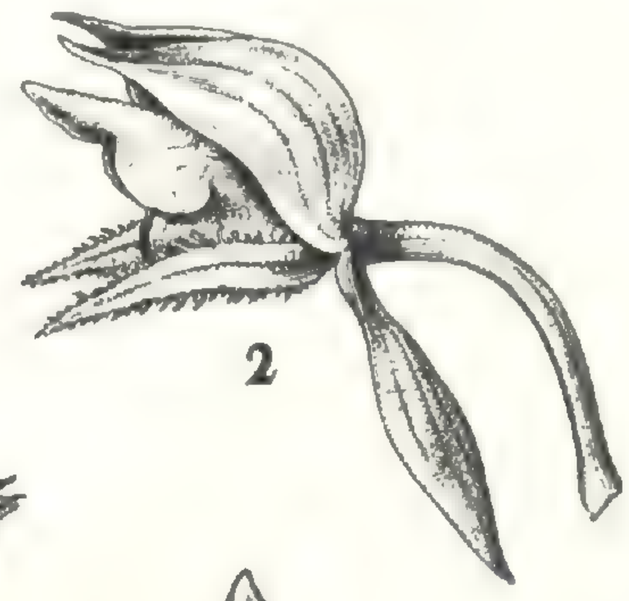
EXPLANATION OF THE ILLUSTRATION

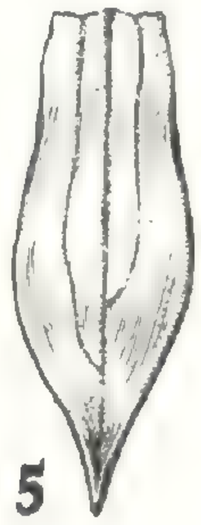
PLATE XIV. EPIDENDRUM FLEXUOSISSIMUM *C. Schweinfurth.* 1, plant, three fourths natural size. 2, flower from the side, natural position, two and one half times natural size. 3, lip and column from the side, natural position, three and one half times natural size. 4, lamina of lip expanded and apex of column, from the front, five times natural size. 5, dorsal sepal, three and one half times natural size.

Drawn by E. W. SMITH

EPIDENDRUM *flexuosissimum* C. Schweinf.





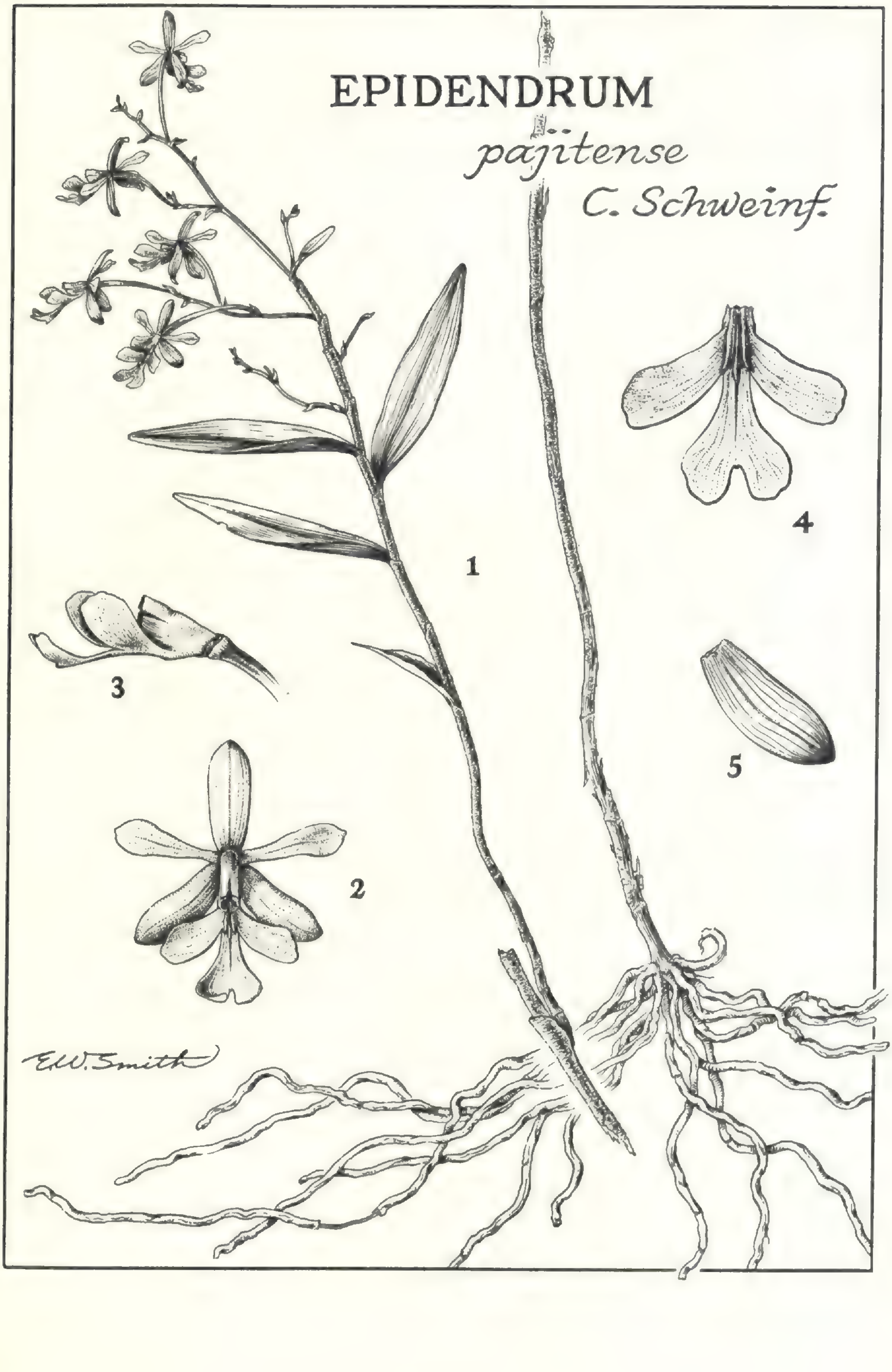


E.W. Smith

EXPLANATION OF THE ILLUSTRATION

PLATE XV. EPIDENDRUM PAJITENSE *C.Schweinfurth.*
1, plant, one half natural size. 2, flower partially expanded, from the front, one and one half times natural size. 3, lip and column from the side, natural position, one and one half times natural size. 4, lamina of lip expanded, from the front, twice natural size. 5, lateral sepal, twice natural size.

Drawn by E. W. SMITH


EPIDENDRUM
pajitense
C. Schweinf.
1
2
3
4
5
E.W. Smith

EXPLANATION OF THE ILLUSTRATION

PLATE XVI. EPIDENDRUM STRICTIFORME *C. Schweinfurth*. 1, plant, seven sixteenths natural size. 2, flower expanded, from the front, two and one half times natural size. 3, column and lip from the side, natural position, two and one half times natural size. 4, lateral sepal, two and one half times natural size.

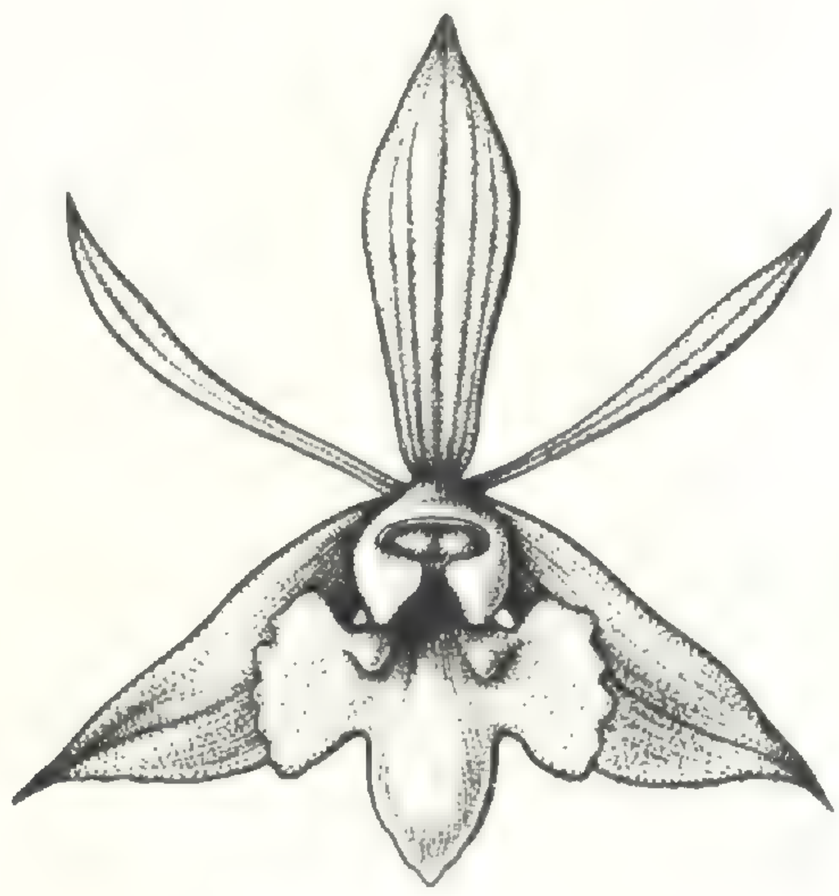
Drawn by E. W. SMITH

EPIDENDRUM

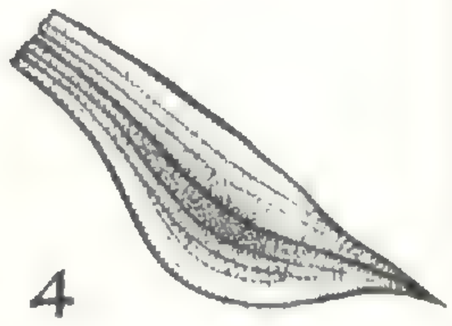
strictiforme

C. Schweinf.

1


2

3

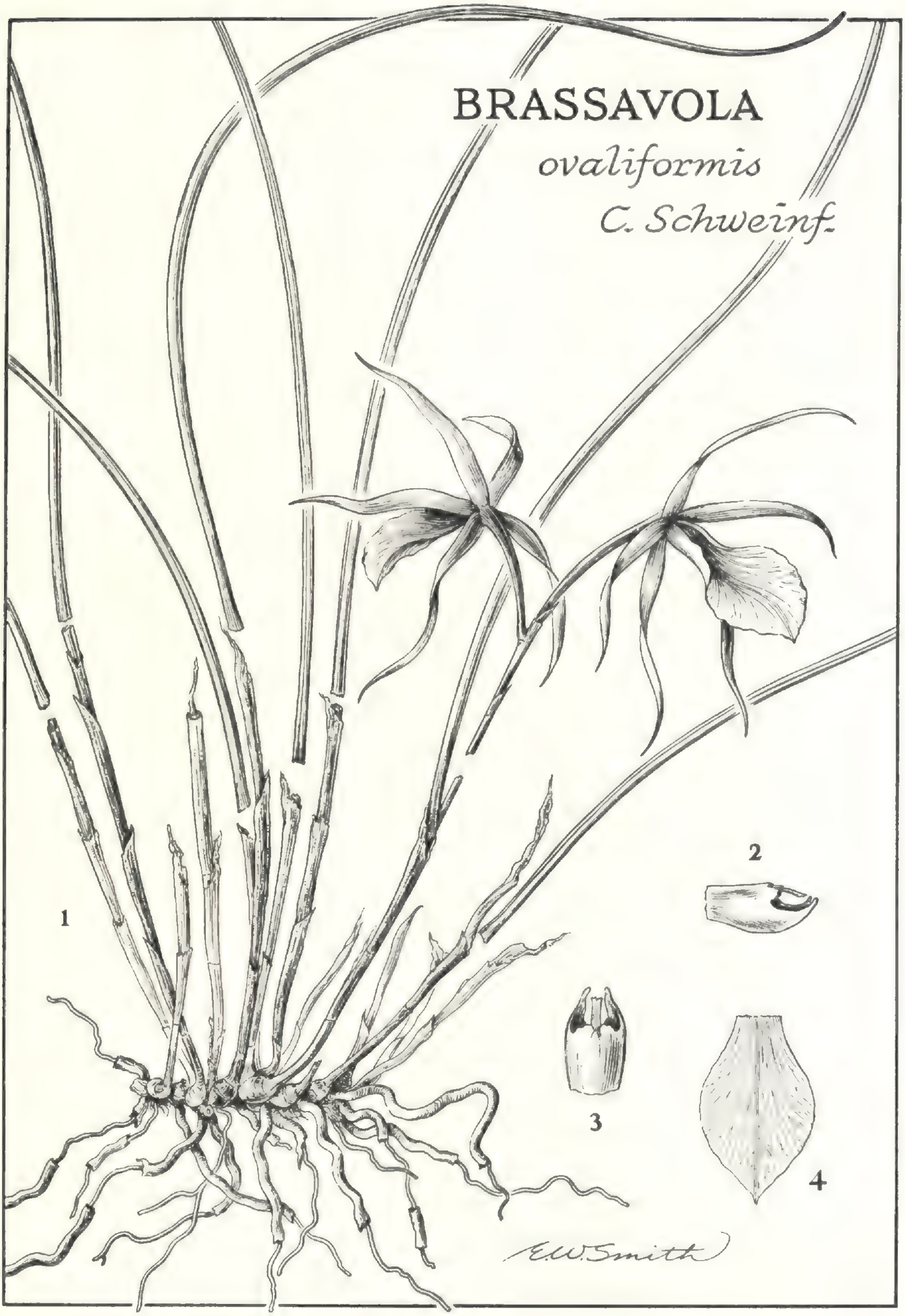

4

E.W. Smith

EXPLANATION OF THE ILLUSTRATION

PLATE XVII. BRASSAVOLA OVALIFORMIS *C. Schweinfurth.* 1, plant, one half natural size. 2, column from the side, twice natural size. 3, column from above, twice natural size. 4, lip expanded, from the front, one half natural size.

Drawn by E. W. SMITH


BRASSAVOLA
ovaliformis
C. Schweinf.
1
2
3
4
E.W. Smith

BOTANICAL MUSEUM LEAFLETS
HARVARD UNIVERSITY

CAMBRIDGE, MASSACHUSETTS, FEBRUARY 6, 1950 VOL. 14, NO. 4

STUDIES IN THE GENUS HEVEA III

BY

RICHARD EVANS SCHULTES[1]

ON THE USE OF THE NAME HEVEA BRASILIENSIS

FOR some time, it has been believed by certain authorities that *Hevea brasiliensis*, the name long used to denote the well known cultivated rubber tree, is untenable if the International Rules of Botanical Nomenclature be strictly interpreted.

Several botanists have written on the complicated problem which underlies this presumed untenability, treating it from differing points of view and with diverging conclusions. This divergency of opinion has led to uncertainty amongst taxonomists not only concerning the actual status of the name *Hevea brasiliensis*, but also as to the authorities to whom it should be attributed.

In 1858, Baillon (Etude Euphorb. (1858) 326) pointed out that the name *Siphonia brasiliensis* HBK. had been applied apparently to two distinct plants: one from the Orinoco and one from the lower Amazon. He proposed to reserve *Siphonia brasiliensis* for the latter—which is our cultivated species—and published a new name (*Siphonia Kunthiana* Baill.) for the former.

Later, in 1900, Warburg (Kautschukpflanzen (1900)

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26) discussed this same problem and resolved, in accordance with what appeared to him to be priority, to keep the name *Hevea brasiliensis* for the Orinoco species and to give the cultivated plant an entirely new name (*Hevea Sieberi* Warb.).

Shortly thereafter, Huber (in Bull. Soc. Bot. France 49, ser. 2 (1902) 43) thought it a better policy to conserve *Hevea brasiliensis* for the cultivated species, and he actually made the proposal that it be so conserved. In 1905, Ule studied the circumstances and also concluded (in Engler Bot. Jahrb. 35 (1905) 664) that the name *Hevea brasiliensis* should be kept for the Brazilian species and *Hevea Kunthiana* used for the concept represented by the Venezuelan collections.

In reviewing the problem recently, Burkill (Dict. Econ. Prod. Malay Penins. 1 (1935) 1159), stated that: "It would lead to much confusion were botanists at this date to displace the . . . . name [*Hevea brasiliensis*], on the ground that *Siphonia brasiliensis* Kunth is not the plant which everyone now calls *Hevea brasiliensis;* yet, if the rules of nomenclature are followed strictly, that, it seems, should happen."

In 1936, Chevalier (in Rev. Bot. Appl. Agric. Trop. 16 (1936) 620) published a most complete review of the historical aspects of the problem. Basing his opinions on a study of the literature, combined with an examination of authentic collections preserved in Paris, he came to the conclusion that the valid name for the cultivated species of *Hevea* is *H. brasiliensis.* In his own words, his conclusion is: "Celle [the collection] du Pará [as opposed to the Orinoco material] doit garder le nom de *Hevea brasiliensis* (Willd.) Muell.-Arg. (excl. syn. H. B. K.)."

Although Chevalier intimated that Willdenow's *Siphonia brasiliensis* had been validly published to denote

what we today call *Hevea brasiliensis*, he did not enter into a discussion of the reason why it was so according to the Rules and why the name cannot, under any circumstances, be applied to the Orinoco material. In spite of the fact that Chevalier's paper constitutes the most important contribution of the century towards a clarification of this question, it has apparently not received the attention it deserves. Baldwin (in Journ. Hered. 38 (1947) 54; ibid. 40 (1949) 47) accepted Chevalier's conclusions, but other investigators who have recently published on *Hevea* (Schultes in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 7; Seibert in Ann. Missouri Bot. Gard. 34 (1947) 305), by using "(HBK.) Muell.-Arg." as authorities for the binomial *Hevea brasiliensis*, have indicated acceptance of the long-established belief that Kunth's publication of *Siphonia brasiliensis* was the earliest.

Cook, in 1941, went much farther than all who had previously discussed this problem. He proposed (in Journ. Wash. Acad. Sci. 31 (1941) 46) to substitute the new name *Siphonia Ridleyana* Cook for our cultivated rubber tree. He rejected the generic epithet *Hevea* on the basis of faulty reasoning and an erroneous understanding of the meaning of the term *homonym*. Even were a new name needed, Cook's substitute specific epithet would be superfluous in view of Warburg's *Hevea Sieberi* of 1900. Cook did not mention Warburg's work in his rather extensive discussion, nor did he indicate by citation or by context that he was familiar with Chevalier's convincing article.

To help end the continued uncertainty in regard to the name of such an important economic plant, and to reiterate Chevalier's conclusion and connect the reasons for it with the corresponding authorizing Article of the International Rules of Botanical Nomenclature, I shall

restate the pertinent historical facts and present as complete a synonymy as possible.

In 1800, Humboldt collected material of *Hevea* along the Río Tuamini near Javita and also along the Río Orinoco at San Fernando de Atabapo, both localities in the upper Orinoco basin of southern Venezuela. These collections were described by Kunth in 1825 under the name *Siphonia brasiliensis*. This has been taken almost unanimously as the first valid publication of the binomial.

In the first decade of the nineteenth century, Count Hoffmannsegg received, presumably from the traveller-collector F. G. Sieber, who worked in Pará from 1801 to 1807, specimens of *Hevea* which he turned over to Willdenow for study. There is strong reason to believe that this material came from the lowermost course of the Río Amazonas. Willdenow annotated the material with the name "*Siphonia brasiliensis* Willd." and deposited it in his herbarium which was preserved at Berlin-Dahlem. These specimens represent the concept which we have come to know as *Hevea brasiliensis*.

When Kunth published the name *Siphonia brasiliensis*, he described the two Venezuelan collections and cited them as the only basis for the description. He did not cite the Brazilian material of Sieber, but he did include in synonymy "*Siphonia brasiliensis* Willd. herb." with the following footnote: "In specimine brasiliensi a Willdenoicum cel. Beauvois communicato (inque Museo Lessertiano asservato) foliola multo minora, subtus pallide viridia (nec albida)." Also in synonymy, he included "Siphoniae species brasiliensis Adr. de Juss. Euphorb. p. 40" and "S. foliolis oblongis, acuminatis. Willd. mss." Willdenow had the habit of making such abbreviated descriptions on herbarium sheets or on envelopes containing specimens, and it is entirely probable that Kunth, who visited the Willdenow herbarium in Berlin,

had copied this himself, for it seems not to have been published elsewhere.

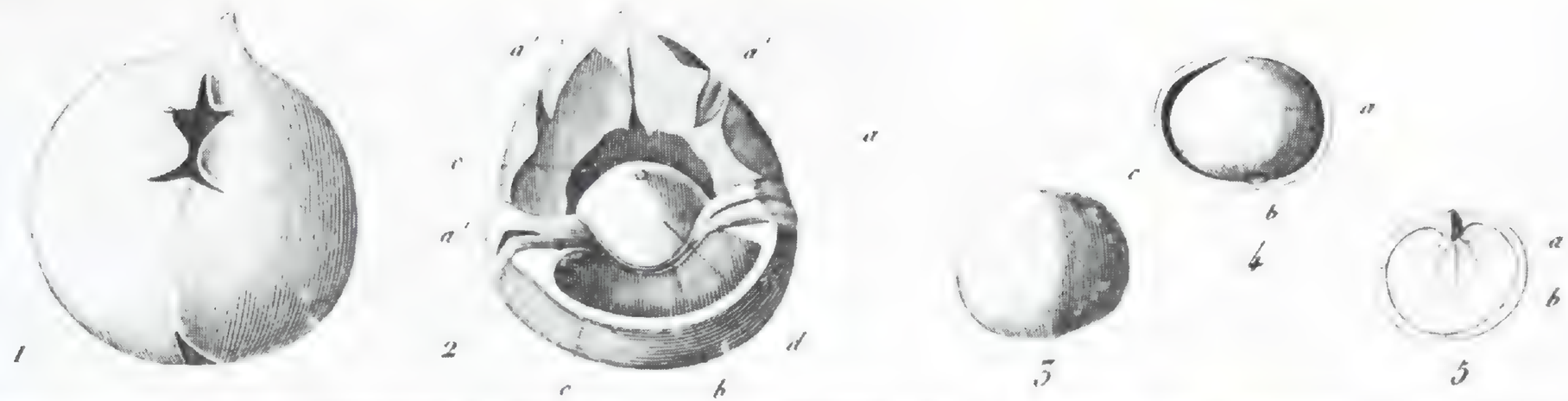
It is quite apparent from a thorough study of the Kunth publication of *Siphonia brasiliensis* that, although he pointed out in the footnote reproduced above that the Brazilian material differed in several characters from the two Venezuelan collections, Kunth himself considered the three collections to represent the same concept. The description, it is also apparent, was based upon the Venezuelan material which, as we now know, definitely does not represent the common cultivated plant but rather a rare species which has, as yet, acquired no commercial importance.

A critical examination of Kunth's treatment discloses an inconspicuous point which seems to have been overlooked and which alters our interpretation of the problem. In their "Nova genera et species plantarum," Humboldt, Bonpland and Kunth were accustomed to indicate names which they were publishing as their own for the first time with a small dagger. In the preface (loc. cit. 1 (1816) vi), they state: "Species et genera nova signo † indicantur." *Siphonia brasiliensis* is *not* marked with a dagger. This, coupled with their citation in synonymy of Willdenow's *Siphonia brasiliensis* (which had been written on an herbarium sheet) would seem to indicate that Kunth was publishing an unpublished Willdenow name. This puzzling situation is completely clarified if, remembering the lack of the dagger in Kunth's publication, we refer to an article by Adr. de Jussieu. It then becomes apparent that Jussieu *validly* published Willdenow's *Siphonia brasiliensis* in 1824, one year before the appearance of Kunth's description. In his "De Euphorbiacearum generibus. . . ." (1824) tab. 12, fig. 38b, 1–6, Jussieu published a plate consisting of diagnostic drawings of the staminate calyx, the stamens with

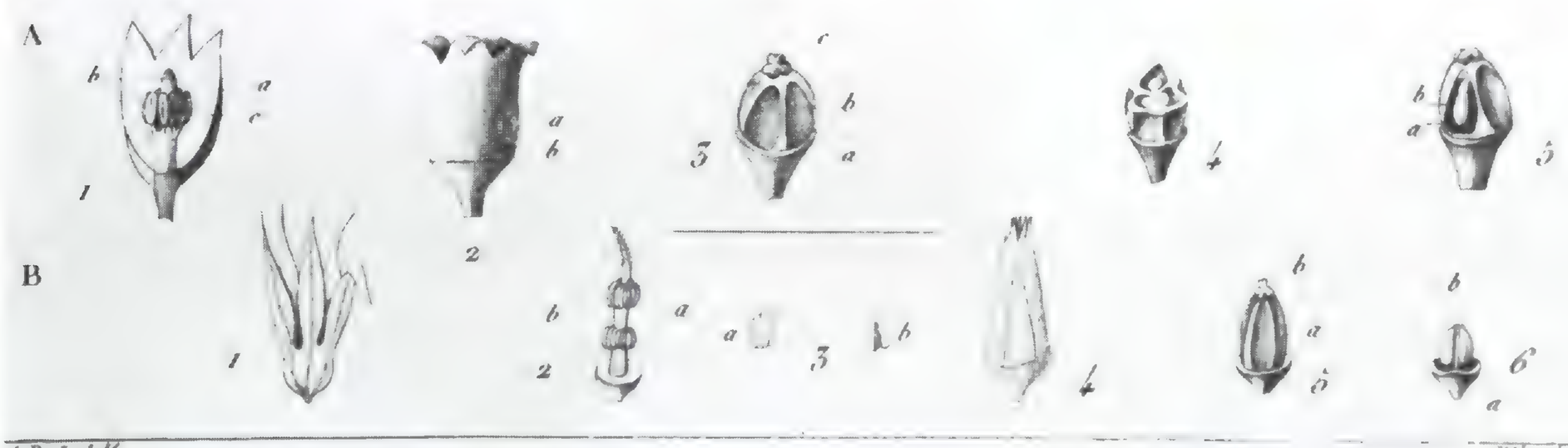
EXPLANATION OF THE ILLUSTRATION

PLATE XVIII. The earliest publication of the name *Siphonia brasiliensis* in Adr. de Jussieu's "De Euphorbiacearum generibus. . . ." (1824) t. 12, fig. 38b, 1-6.

37.



38.



A.D.J. del.

Thér. père sculp.

36. *ALEURITES ambinux*. 37. *ANDA gomesii*.

38. A. *SIPHONIA elastica*. B. *S. brasiliensis*.

EXPLANATION OF THE ILLUSTRATION

PLATE XIX. A specimen of the type collection of *Hevea brasiliensis* preserved in the Paris Herbarium.

PLATE XIX

HERB. MUS. PARIS

H. Brasiliensis
J. F. Baldwin, jr.
25/6/46

the anthers and suprastaminal column, the pistillate flower, the pistil and the ovary of "*Siphonia brasiliensis* W. (in herbariis)." In accordance with Article 44 of the Rules, this constitutes valid publication, for the name of a species is validly published if it be accompanied "by a plate or figure with analyses showing essential characters; but this applies only to plates or figures published before January 1, 1908."

When Mueller transferred the specific epithet from *Siphonia* to *Hevea* in 1865, he was probably unaware of the discrepancy between the Orinoco and the Amazon collections—and this in spite of Baillon's insistence on that point in 1858. In making the new combination, Mueller based it on "*Siphonia brasiliensis* Kunth in Humb. et Bonpl. Nov. Gen. et Spec. 7, p. 171" and cited "*S. Kunthiana* Baill." as a synonym. It is significant, however, that the Brazilian material ("In Brasilia paraënsi, Hoffmansegg in hb. Willd. fol. 17936. p. 1") was cited before the Venezuelan collections. It is because the author of this combination, apparently unaware of Jussieu's paper, attributed the earliest publication to Kunth that the author citation of *Hevea brasiliensis* has been erroneously written as "(HBK.) Mueller-Argoviensis" by almost all taxonomists.

In summary, we may say that the proper and valid name of the cultivated rubber tree is

Hevea brasiliensis (*Willd. ex Adr. de Juss.*) *Mueller-Argoviensis* in Linnaea 34 (1865) 204.

Its synonymy is as follows:

Siphonia brasiliensis Willdenow ex Adr. de Jussieu Euphorb. Gen. (1824) t. 12, pl. 38b., fig. 1–6. *Non Siphonia brasiliensis* HBK. Nov. Gen. et Sp. 7 (1825) 171.

Hevea janeirensis Mueller-Argoviensis in Martius Fl. Bras. 11, pt. 2 (1874) 706.

Hevea Sieberi Warburg Kautschukpf. (1900) 32, fig.

Hevea Randiana Huber in Bol. Mus. Goeldi 4 (1906) 636.

Hevea brasiliensis var. *stylosa* Huber (loc. cit. 4 (1906) 640.

Hevea brasiliensis var. *janeirensis* (Muell.-Arg.) Pax in Pflanzenr. 4 (1910) 121.

Hevea brasiliensis var. *Randiana* (Huber) Pax loc. cit. 4 (1910) 123.

Hevea brasiliensis mut. *Granthami* Bartlett in Bot. Gaz. 84 (1927) 200.

Hevea Granthami Bartlett loc. cit. 84 (1927) 200, *nomen alt. anteriori.*

Hevea brasiliensis forma *typica* Ducke in Arch. Jard. Bot. Rio Janeiro 6 (1933) 55.

Hevea brasiliensis var. *subconcolor* Ducke loc. cit. 6 (1933) 55.

Hevea brasiliensis forma *subconcolor* Ducke in Arch. Inst. Biol. Veg. Rio Janeiro 2 (1935) 224.

Hevea brasiliensis forma *Randiana* (Huber) Ducke loc. cit. 2 (1935) 224.

Siphonia Ridleyana Cook in Journ. Wash. Acad. Sci. 31 (1941) 46.

Siphonia janeirensis (Muell.-Arg.) Cook loc. cit. 31 (1941) 61.

The varietal names which follow, included by Seibert (loc. cit. 305–306) as synonyms of *Hevea brasiliensis*, are here omitted pending additional studies which may possibly indicate that they are distinct concepts.

Hevea brasiliensis var. *angustifolia* Ule in Tropenpflanz. Beiheft. 6 (1905) 8.

Hevea brasiliensis var. *latifolia* Ule loc. cit. 6 (1905) 8.

Hevea brasiliensis var. *acreana* Ule in Engler Bot. Jahrb. 50 (1914) 14.

For his friendly counsel in this as in many other problems which have arisen in my botanical research, I am deeply grateful to the late Mr. Charles A. Weatherby of the Gray Herbarium of Harvard University.

THE IDENTITY OF UCUQUÍ

BY

JOÃO MURÇA PIRES[1] AND RICHARD EVANS SCHULTES[2]

ONE of the results of recent field work in the upper Rio Negro basin of Brazil has been the identification of a useful plant of that area—the *ucuquí*. The fruit of this tree has an edible and delicious mesocarp and is an important part of the diet of the native peoples of the region.

Investigation has shown that the *ucuquí* is an undescribed species of the sapotaceous genus *Pouteria*. It is altogether fitting that, in publishing a description of this food plant, we employ as a specific epithet the common name which refers exclusively to this species over the greater part of its range.

Pouteria Ucuqui is immediately set apart from all other species of the genus by the excessively developed disk which surrounds the ovary.

Pouteria Ucuqui *Pires & Schultes sp. nov.*

Arbor enormis, usque ad centum viginti pedes alta, radicibus tabularibus, trunco columnari usque ad tres pedes in diametro, cortice crasso, molli, extus atrobadio

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[2] Botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U.S. Department of Agriculture; Research Fellow, Botanical Museum, Harvard University; Collaborator, Instituto Agronômico do Norte.

et intus sanguineo cum latice albo aquosoque. Ramuli juniores, inflorescentiae, petioli et foliorum nervi indumento ferrugineo-pulverulento vel ferrugineo-furfuraceo obtecti. Folia alterna, bene coriacea, elliptica, basi et apice acuta vel obtusiuscula, plerumque cum acumine 7–10 mm. longo, margine integra, 11–20 cm. longa, 5.5–10 cm. lata, supra nitidula, subtus opaca (statu bene juvenili ferruginea), minutissime ferrugineo-pilosula; costa leviter striata, supra prominens, subtus valde elevata et robusta; nervi secundarii utrinque octo ad quindecim, supra leviter inculpti, subtus valdissime prominentes; venulae superficie utraque paulo impressae. Petiolus elongatus, siccitate striatus et leviter rugosus, saepissime 3.5–5.5 cm. longus, 2–3 mm. in diametro. Inflorescentiae axillares, valdissime congestae, fasciculatae. Flores mordaciter fragrantes, flavo-virides, gemmationis statu longe persistentes sed flores ipsi fugaces. Sepala quinque, imbricata, subrotundata, plerumque 2 mm. longa, utrinque minutissime adpresso-pilosa, intus demum glabrescentia. Petala quinque, per $\frac{1}{3}$ vel $\frac{2}{3}$ longitudinis partem connata, imbricata, oblonga, apice acutiuscula vel obtusa, margine integra, plerumque 3 mm. longa, 1 mm. lata, extus pilosiuscula sed demum glabrescentia, intus subglabra, tubo vulgo 0.5–1 mm. longo. Stamina quinque, petalis opposita, filamentis vix 1 mm. longis; antherae apice acutae, basi rotundatae, connectivo mediano crasso, loculis duobus, sublinearibus, rimis oppositis, dehiscentibus. Staminodia petalis alterna, apice acuta, 1 mm. longa vel minora, aliquando inconspicua. Ovarium biloculare, minutissimum, pilosum, disco valde hispido, circiter 0.5 mm. alto circumdatum; stylus circiter 1.2 mm. longus, pilosus vel glabrescens, cum stigmatibus inconspicuis. Fructus maximus, 9–13 cm. longus, 5–7 cm. in diametro, monospermus; semen magnum, plerumque 7–10 cm. longum, 3.5 cm. latum, 3 cm. in di-

ametro, cum testa crustacea, nitida, plusminusve 2 mm. crassa, area umbilicali magna.

Arbor a regionis typicae brasiliensis incolis *ucuquí* (in lingua nheenagtú), *puch-pee-á* (in lingua tukanorum tribus); a regionis colombianae incolis *oó-le-da* (in lingua kuripakanorum tribus), *ka-he-pa* (in lingua mirañorum tribus) appellatur.

COLLECTIONS EXAMINED:

BRAZIL: Estado do Amazonas, Upper Rio Negro, Igarapé Uabá, opposite mouth of Rio Xié. "Immense tree, 110 feet tall, with wide-spreading crown. Large buttress roots up to 6 feet. Tree columnar, $2\frac{1}{2}$ to 3 feet in diameter. Bark dark brown, shaggy externally, red internally, soft, $\frac{1}{2}$–$\frac{3}{4}$ inch thick. Latex sparse, white. Wood of medium hardness, compact, white. Flowers in extremely dense clusters, falling easily. Sepals greenish; petals white; anthers brown, apparently odourless. Common name: *ucuquí.*" January 5, 1948, *Richard Evans Schultes & Francisco López 9553* (TYPE in Herb. Gray; DUPLICATE TYPES in Herb. Inst. Agron. Norte (Belém do Pará); U.S. Nat. Herb.; Kew; Econ. Herb. Oakes Ames).—Rio Issana basin, between Rio Aiarí and Rio Caiarí (Uaupés), near Serra Tunuí. "Arvore 25 m. × 40 cm. Frutos estimados como alimento indígena. *Ucuquí.*" October 13, 1945, *Ricardo de Lemos Fróes 21388.*—Rio Negro, near Uaupés (Sao Gabriel), Serra de Uanarí "*Ucuquí.* Arvore muito grande. Latex branco, pegajoso, página inferior da folha revestida por leve indumento escamoso ferrugineo, fruto amarelado." October 26, 1947, *Joao Murça Pires 773.*—Same locality. "*Ucuquí.* Arvore muito grande. Latex branco, pegajoso, página inferior da folha revestida por leve indumento escamoso ferrugineo; fruto amarelo." October 30, 1947, *Joao Murça Pires 799.*—Same locality. "*Ucuquí.* Arvore muito grande no alto da serra. Floras quasi brancas (botoes)." November 17, 1947, *Joao Murça Pires 1165.*—Rio Negro, near confluence with Rio Uaupés. "*Ucuquí.* Arvore muito grande. Madeira dura. Latex branco, pegajoso. Pagina inferior da folha revestida por leve indumento escamoso, ferrugineo, amarelado." November 5, 1947, *Joao Murça Pires 833.*—Rio Uaupés, Serra Uapicí. "*Ucuquí.* Arvore grande." November 17, 1947, *Joao Murça Pires 1150.*—Rio Negro, near Uaupés (Sao Gabriel). "*Ucuquí.* Arvore platinhas novas, colhidas sob a arvore." October 30, 1947, *Joao Murça Pires 792.*—Rio Uaupés, Ipanoré "*Puh-piá.* Arvore grande." November 15, 1947, *Joao Murça Pires 1057.*—Rio Uaupés, Taracuá.

"*Ucuquí*, (lingua geral). *Puh-piá* (Tukano), November 8, 1947, *João Murça Pires 905*.—Rio Uaupés, Serra Uapicí. "*Ucuquí*. Arvore grande." November 17, 1947, *Joao Murça Pires 1149*.—Rio Negro, Sao Gabriel. "*Coquí*. Enormous tree. Buds brownish. Fruit edible." November 20–25 1947, *Richard Evans Schultes & Francisco López 9184*. —Rio Negro, Sao Gabriel. "*Ucuquí*. Enormous tree." January 14, 1948, *Richard Evans Schultes & Francisco López 9618*.—Middle Rio Negro basin, Rio Curicuriarí. "Ucuquí." *Richard Evans Schultes & Francisco López 9710*.—Rio Negro, Ipanoré. Caatinga forest beyond town. "*Coquí*. Enormous tree. Fruit edible." November14–15, 1947, *Richard Evans Schultes & Joao Murça Pires 9096*.

COLOMBIA: Comisaría del Vaupés, Río Negro, opposite Piedra del Cocuy. "Enormous buttressed tree, 110 feet tall, diameter 3 feet. Flowers greenish yellow. Bark shaggy, brown. Fruit edible." December 28, 1947, *Richard Evans Schultes & Francisco López 9484*.—Río Guainía, near Sejál. "Tree 100 feet tall, buttressed. Kuripaka name: *oó-le-da*." June 1948, *Richard Evans Schultes & Francisco López 10058a*.—Comisaría del Amazonas, Río Caquetá, near La Pedrera. "Enormous tree. Fruit edible. Miraña name: *ká-hĕ-pa*." July 15, 1948, *Richard Evans Schultes & Francisco López 10215*.

VENEZUELA: Territorio del Amazonas, Río Negro, base of Piedra del Cocuy. "Enormous tree 120 feet tall, $2\frac{1}{2}$ feet in diameter, slightly buttressed. Bark brown, shaggy, soft, scarlet within. Latex sparse, white. Buds greenish yellow." December 24, 1947, *Richard Evans Schultes & Francisco López 9458*.

Pouteria Ucuqui is very common in the northwesternmost part of the Brazilian State of Amazonas along the upper Rio Negro, from Tapurucuara (Santa Isabel) upstream, and along its affluents: the Uaupés, Issana, Tikié, Curicuriarí, Dimití, and probably many others. It is known to occur in Colombia in the Ríos Guainía (constituting the source of the Río Negro) and on the Río Caquetá. It has also been found on the Japurá in Brazilian territory and has been reported from the Río Solimões (Le Cointe, P. "Arvores e plantas uteis" (1934) 457). According to reliable reports, it occurs in certain places far into Venezuelan territory along the lower course of the Río Guainía and on the Casiquiare itself.

In this entire area, the plant—an enormous, heavily crowned tree which fruits profusely once a year—is found in abundance in the virgin forest on high, well drained soil. It is also often encountered in a state of apparent cultivation, since, in clearing for house sites, the tree has been spared. When completely ripe, the thick, fleshy mesocarp of the fruit, which resembles that of the avocado (*Persea americana* Mill.) to a striking degree, is very palatable. When green, however, it is full of latex and is extremely sticky.

Pouteria Ucuqui is known in the entire Brazilian part of its range by the name *ucuquí*, a word originating from the Lingua Geral or Nheengatú language which is spoken widely in the State of Amazonas, and especially in the Rio Negro. The Tukano Indians of the Rio Uaupés refer to the tree as *puch-pee-á* (the *ch* being soft as in the German *ich*). In Colombia, the native name for *Pouteria Ucuqui* amongst the Kuripaka Indians of the Río Guainía is *oó-le-da;* and amongst the Mirañas of the Río Caquetá (La Pedrera), *ká-he-pa*. The tree is called *yucú* by the Spanish-speaking population of the Venezuelan town of San Carlos on the uppermost Río Negro.

The term *ucuquí*, so far as we have been able to ascertain, refers exclusively to *Pouteria Ucuqui* and should not be confused with *ucuquirana* (i.e., "false *ucuquí*"), a name widely applied in the same area to the sapotaceous *Ecclinusa sanguinolenta* Pierre (*E. Balata* Ducke)—also called *abiurana*—a tree which is actively exploited as the source of a type of balata. The two trees are completely distinct from all points of view.

Pouteria Ucuqui is a very tall and robust tree, usually with comparatively large buttresses at the base; the lowest branches are at a great height from the ground. These conditions make the study and collection of herbarium material rather difficult, especially since the flowers,

which are borne on the branchlets, are very minute and cannot be seen from the ground, even with binoculars.

Dr. Adolpho Ducke, who has visited the upper Rio Negro basin several times, was unable to collect flowering material of *uenquí*, although he devoted special attention to this tree which he believed represented an undescribed species. Without flowering material, however, there was some question as to even its generic affinities.

When we began our work in the upper Rio Negro in late 1947, Dr. Ducke counseled us to try to find flowering material which would settle definitively the identity of *uenquí*. With this in mind, we studied a number of individuals over a wide area. It was almost always necessary to use the balatero's climbing-irons (employed during the extraction of balata from species of *Manilkara*), since the girth of the tree usually prevented the use of the "peconha" (a band of pounded bark which the Indians place on the feet to aid them in climbing). The expertness of our assistant, the late Francisco López, in the use of the climbing-irons greatly increased the number of trees which we could study.

During October and November, this work was carried on principally by Murça Pires. At first, sterile specimens only were obtainable. Then, gradually, we began to secure material which was in bud. No flowers, however, were found, and we later learned that the species develops the flower with extreme slowness, persisting in bud sometimes for three or four months. Many experiments were tried to force the buds to open: sun, artificial heat, soaking in hot and warm water; but all these efforts failed.

It is interesting in this connexion to note how little the natives know about the life-history of this species, even though it is one of their common and useful plants. Repeated questioning on our part brought forth the most divergent and amusing remarks concerning the flowering

of *ucuquí*. Many, when asked during what month the tree flowers, replied that they had never seen it flower and that, therefore, it did not flower. Others insisted that the tree blooms during the night and immediately drops all the flowers. This second "explanation" is, in a way, ingenious, because, as we later witnessed, the forest floor under an *ucuquí* tree, where there had even the day previously been no indication of blossoms, would suddenly be covered with literally hundreds of thousands of flowers or parts of flowers. Our studies showed that, in spite of the very long period of aestivation, the flowers are almost ephemerous in *Pouteria Ucuqui*.

During the last few months of 1947, Murça Pires revisited trees in bud several times in an attempt to collect fertile specimens. When he returned to Belém, Schultes and López continued the search. In late December, it was noted that the buds on a number of trees previously examined were swelling rapidly, in spite of the fact that for at least a month previous there had been no appreciable alteration in their size.

On January 5, we found our first flowering tree. It was very early in the day, about six o'clock in the morning, when our attention was called to the tree by the patter of falling flowers. Upon climbing the tree, we noted a very strong aromatic and pungent odor. It is significant to note that the buds never had a fragrance. There were innumerable large bees and several other kinds of smaller insects visiting the flowers even at this early hour. Later, we encountered other trees in flower, but the pronounced odor was not noted. It is possible that the strong, aromatic fragrance is given off only for a short period during the very limited blossoming time. As accurately as we could calculate, open flowers persist for no longer than three days on an individual tree and usually are much shorter lived.

EXPLANATION OF THE ILLUSTRATION

PLATE XX. POUTERIA UCUQUI *Pires & Schultes.* A, flowering branch, about one half natural size. B, fruit. C, seed. D, flower. E, dissection and view of interior of corolla. F, dissection of flower showing disk around ovary. G, dissection of flower showing pilosity around ovary. H, anther. Each drawing has a millimeter scale to indicate magnification.

Drawn by PEREIRA FILHO
of Instituto Agronômico do Norte

PLATE XX

POUTERIA *Ucuquii* *Pires & Schultes*

EXPLANATION OF THE ILLUSTRATION

PLATE XXI. POUTERIA UCUQUI *Pires & Schultes.* Basal portion of trunk of type tree, showing the buttress roots.

Photograph by R. E. SCHULTES

Plate XXI

EXPLANATION OF THE ILLUSTRATION

PLATE XXII. POUTERIA UCUQUI *Pires & Schultes.*
Inflorescences from branchlets of type tree.
Photograph by R. E. SCHULTES

Plate XXII

EXPLANATION OF THE ILLUSTRATION

PLATE XXIII. POUTERIA UCUQUI *Pires & Schultes*.
Flowers from type tree.

Photograph by R. E. SCHULTES

Plate XXIII

A century set (i.e. one hundred herbarium specimens) was collected from the type tree for distribution by the Gray Herbarium of Harvard University. Floral material was also obtained from the same tree and preserved in alcohol and glycerine for use in drawing up the description.

An interesting Indian use of *ucuquí*, discovered by Fróes along the Rio Japurá, is the manufacture of toy whistles from the seeds. All of the interior of the seed (the cotyledons) is removed and a number of holes, over which the fingers are placed, are made. In popular medicine in Amazonian Brazil, the fruit is sometimes employed as a vermifuge (Le Cointe loc. cit.).

The earliest and, in fact, the only reference of an extended nature to *ucuquí* which has come to our attention is Wallace's interesting discussion of the plant (Wallace, A. R. "A narrative of travels on the Amazon and Rio Negro" ed. G. T. Bettany (1889) 243–244). Because of its historical significance, we quote it in full. "Of a passing Indian [on the Rio Uaupés] I bought a basket of Ocokí, and some fish. The Ocokí is a large pear-shaped fruit, with a hard thick outer skin of almost woody texture, then a small quantity of very sweet pulpy matter, and within a large black oval stone. The pulp is very luscious, but is so acrid as to make the mouth and throat sore, if more than two or three are eaten. When, however, the juice is boiled it loses this property; and when made into mingau with tapioca, is exceedingly palatable and very highly esteemed in the Upper Rio Negro, where it is abundant. It takes at least a peck of fruit to give one small panella of mingau.

"On the next day, the 10th in the afternoon, the Indians all suddenly sprang like otters into the water, swam to the shore, and disappeared in the forest. 'Ocokí' was the answer to my inquiries as to the cause of their sudden disappearance; and I soon found they had discovered

an ocokí-tree, and were loading themselves with the fruit to satisfy the cravings of hunger, for the Indian's throat and mouth seem invulnerable to all those scarifying substances which act upon civilised man. The tree is one of the loftiest in the forest, but the fruit falls as soon as ripe, and its hard woody coating preserves it from injury. Baskets, shirts, trousers, etc,, were soon filled with the fruit and emptied into the canoe; and I made each of the Indians bring a small basketful for me; so that we had 'mingau de ocokí' for three succeeding mornings."

THE CORRECT NAME OF THE YAUPON

BY

RICHARD EVANS SCHULTES[1]

DURING a recent conversation with me regarding the nomenclature of the yaupon, Professor Oakes Ames called my attention to a precious remark which Dillenius once wrote in a letter to Linnaeus (Smith, J. E.: "A selection of the correspondence of Linnaeus and other naturalists" 2 (1821) 96). "We all know the nomenclature of Botany to be an Augean stable, which C. Hoffman, and even Gesner, were unable to cleanse." Nothing could be more expressive of the confusion which one encounters in the synonymy of this holly than the term "Augean stable."

There has long been a need for a thorough discussion of the correct name of the yaupon, the source of the black-drink once so commonly used as a ceremonial emetic and stimulant amongst Indians of the southeastern part of the United States.

The monographer of the *Aquifoliaceae*, Loesener (Monogr. Aquifol. in Nova Acta Acad. C. L. C. G. Nat. Cur. 78 (1901)) employed the binomial *Ilex caroliniana* (Lam.) Loes. Most modern taxonomic treatments, however, use *Ilex vomitoria* [Soland. in] Ait.

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Notwithstanding this tendency in botanical works, a most baffling confusion and uncertainty still exists throughout the numerous chemical, pharmacological, anthropological and ethnobotanical publications and hampers understanding and accuracy. In view of the lack of any adequate review of the taxonomic and nomenclatorial history of this plant since 1753, it has seemed advisable to present the following notes in an attempt to set forth the reason why the correct, though not the earliest, name is *Ilex vomitoria* and to discuss the origin, status and significance of the synonymy of this binomial.

Ilex vomitoria [*Solander* in] Aiton Hort. Kew. [ed. 1] 1 (1789) 170.

I. Cassine β Linnaeus Sp. Pl. 1 (1753) 125.
Cassine Paragua Miller Gard. Dict. [ed. 8] (1768) Cassine no. 2. Non *Cassine Peragua* Linnaeus Sp. Pl. [ed. 2] (1762) 384. Non *Cassine Peragua* Linnaeus Mant. 2 (1771) 220.
C. caroliniana Lamarck Dict. 1 (1783) 652, *pro parte*.
I. Cassine Walter Fl. Carol. (1788) 241.
I. ligustrina Jacquin Collect. 4 (1790) 105; Icon. Rar. 2 (1793) 9, t. 310.
Casine yapon Bartram Travels (1791) 259, *nom. nud.*
I. floridana Lamarck Ill. 1 (1791) 356.
I. Cassena Michaux Fl. 2 (1803) 229.
I. religiosa Barton Fl. Virg. (1812) 66.
? Cassine ramulosa Rafinesque in Robin Fl. Lud. (1817) 110.
Hierophyllus Cassine (Walt.) Rafinesque Med. Bot. 2 (1830) 8.
? Cassine amulosa Rafinesque Med. Fl. 2 (1830) 205, *nom. sphalm.*
Ageria Cassena (Michx.) Rafinesque Sylv. Tellur. (1838) 47.

? *Emetila ramulosa* Rafinesque in S. Watson Bibl. Ind. N. Am. Bot. (1878) 158, *nom. in syn.*

Cassine yaupon Gatschet in Trans. St. Louis Acad. Sci. 5 (1888) 88, *nom. nud.*

I. Peragua (L.) Trelease in Trans. Acad. Sci. St. Louis 5 (1889) 346, *in obs.*

I. caroliniana (Lam.) Loesener in Bot. Centralbl. 47 (1891) 163.

I. vomitoria [Soland. in] Aiton var. *Yarkeyii* Tarbox Some Nat. Hollies in Brookgreen Gardens (1944) 19, *sine diagn. lat.*

Cassine vomitoria Swanton in Bull. Bur. Am. Ethnol. 137 (1946) 284, *nom. nud.*

Perhaps the earliest widespread reference to the yaupon in a botanical publication was made by Bauhin and Cherler in their encyclopaedic "Historia plantarum universalis" 3 (1651) 631. No description of the plant was given. The title, "Herba Cassiana, famen sitimque retardans," of the brief discussion, which reported the use of the infusion of the leaves as a stimulant, referred to the hunger-allaying properties of the shrub. This reference is an elaboration of an earlier report by Bauhin (Pinax (1623) 170), based upon what appears to be the first account of the black-drink (Nuñez Cabeça de Vaca "Relación y comentarios. . . ." (1542) cap. 26), herein reproduced (Plate XXIV).

Later, Leonard Plukenet described the species as *Cassine vera Floridanorum Arbuscula baccifera Alternati ferme facie, foliis alternatim sitis, tetrapyrene* ("Opera omnia botanica" 3 (1691) 40) and published what is apparently the earliest illustration (loc. cit. 4 (1692) t. 376, f. 2). No mention seems to have been made of the use of the plant.

It is to Mark Catesby ("The natural history of Carolina, Florida and the Bahama Islands" 2 (1754) 57) that we are indebted for the first definite and convincing iden-

tification of the source of the black-drink which, for 235 years previously, had been attracting the attention of travellers. This was accomplished through Catesby's charming plate and his description of Plukenet's *Cassine vera Floridanorum Arbuscula baccifera Alternati ferme facie, foliis alternatim sitis, tetrapyrene*, together with a very lengthy account of the properties and ceremonial uses of the plant.

The earliest tenable post-Linnaean name for the yaupon is found in volume one of the first edition of Aiton's "Hortus Kewensis" (1789). It was here named *Ilex vomitoria*. The specific epithet would indicate that Solander, who described the plant, was familiar with its renown as an emetic, although he made no mention of this in his notes. The original description is short: "I. foliis alternis distantibus oblongis obtusiusculis crenato-serratis: serraturis muticis."

It will be noted that Miller's *Cassine Paragua*, (1768) referring, without any doubt, to the concept now under consideration, antedates *Ilex vomitoria*. We must investigate the reasons for the untenability of Miller's binomial, because of the almost unbelievable confusion of his specific epithet and Linnaeus' several concepts—all named *Cassine Peragua* or the orthographic variant *C. Paragua*. Notwithstanding the unavailability of the epithet *Peragua*, the combination under *Ilex* has been made. We must realize, however, that the author did not urge its acceptance. Trelease, although he accepted *Ilex Cassine* Walt. as the correct name for the yaupon holly, wrote in a footnote (in Trans. Acad. Sci. St. Louis 5 (1889) 346, *in obs.*): "An effort to improve on the nomenclature of this species, unless it is called *I. Cassine* β L. Sp. (1753) 125, would probably cause it to stand as *I. Peragua* (L.)=*Cassine Peragua* L. Mantiss. (1771), ii, 200."

In 1762, Linnaeus (Sp. Pl. [ed. 2] 1 (1762) 384) published *Cassine Peragua* for an Old World concept. He cited several sources which indicate that the concept was unquestionably an Old World one. Although one of these sources (Hortus Cliffortianus (1737) 72) attributed the plant both to the Cape of Good Hope *and* to Carolina, it is clear that it was not being confused with the concept now known as *Ilex vomitoria* which was discussed separately (loc. cit. 40) and was attributed to "Carolina *Americae.*"

Cassine Peragua was published again by Linnaeus nine years later (Mant. 2 (1771) 220). In this second Linnaean publication, it referred not to the Old World concept of the earlier (1762) *Cassine Peragua* but to several different concepts.

Linnaeus' *Cassine Peragua* of 1771 has hitherto been considered by some taxonomists as a synonym of *Ilex vomitoria*, either wholly or in part. There has been much uncertainty as to the exact meaning of this name, because, in the Linnaean Herbarium, there are two distinct American plants under the binomial. Loesener (in Engler Bot. Jahrb. 28, 2 (1900) 154–155) considered *Cassine Peragua* L. of 1771 as a *nomen nudum*. Fernald and Schubert (in Rhodora 50 (1948) 169) hold it to be a *nomen ambiguum* and a *nomen confusum* and suggest that it be permanently rejected. Photographs of the two specimens indicate that neither is referable to *Ilex vomitoria;* both are species of *Viburnum* (Fernald and Schubert loc. cit.). Therefore, whether *Cassine Peragua* L. of 1771 be rejected or not, there is no need of considering further the name in any discussion of the synonymy of *Ilex vomitoria*. Trelease's combination, *Ilex Peragua* is untenable since it is based on a homonym.

Cassine Paragua Miller (Gard. Dict. [ed. 8] (1768) *Cassine* No. 2), on the contrary, is very definitely referable to

EXPLANATION OF THE ILLUSTRATION

PLATE XXIV. The earliest European account of the use of the black-drink was written by Nuñez Cabeça de Vaca and published in his "Relación y commentarios. . . ." of which there have been several editions. The illustration is a photograph of the account as it appears in the first edition of 1542. Of this rare and fascinating book only two copies are known: an imperfect copy preserved in the British Museum; and a perfect one in the New York Public Library, through the kind cooperation of which institution the photograph herein reproduced was made available.

tierra se emborrachan cõ vn humo y dã quãto tienen por el. beuen tambien otra cosa q sacan de las hojas delos arboles como de enzina y tuestanla en vnos botes al fuego/y despues q la tienen tostada hinchen el bote de agua y assi lo tienen sobre el fuego/y quando ha heruido dos vezes echan le en vna vasija y está en friandola con media calabaça: y quando esta con mucha espuma beuen la tan caliente quanto pueden sufrir: y desde que la sacan del bote hasta que la beuen estan dando bozes diziendo que quien quiere beuer. Y quando las mugeres oyen estas bozes luego se paran sin osar se mudar/y aunq̃ esten mucho cargadas no osan hazer otra cosa. y si a caso alguna dellas se mueue la deshonrran y la dan de palos/y con muy gran enojo derraman el agua que tienen para beuer: y la que an beuido la tornan a lançar lo qual ellos hazen muy ligeramente y sin pena alguã. la razon desta costumbre dã ellos/y dizen. Que si quãdo ellos quieren beuer aquella agua las mugeres se mueuen de donde les toma la boz que en aquella agua se les mete enel cuerpo vna cosu mala y q̃ dẽde a poco les haze morir. y todo el tiẽpo q̃ el agua esta coziendo a de estar el bote atapado Y si a caso esta desatapado y alguna muger passa lo derramã y no beuen mas de aq̃lla agua/es amarilla. y estan beuiendola tres dias sin comer: y cada dia beue cada vno arroba y media della. E q̃ndo las mugeres estã cõ su costumbre no buscan de comer mas de para si solas porq̃ ninguna otra persona come delo que ella trae. Enel tiẽpo q̃ assi estaua entre estos vi vna diablu

EXPLANATION OF THE ILLUSTRATION

PLATE XXV. The plant which was the source of the black-drink was definitely identified in 1754 by Mark Catesby, as evidenced by this beautiful illustration from his "The natural history of Carolina, Florida and the Bahama Islands" 2 (1754) 57.

Plate XXV

EXPLANATION OF THE ILLUSTRATION

PLATE XXVI. The discussion of the black-drink accompanying Catesby's plate.

Caſſena vera Floridanorum, Arbuſcula baccifera Alaterni facie, foliis alternatim ſitis, tetrapyrene. Pluk. Mant.

THIS Shrub uſually riſes from the ground with ſeveral ſtems, to the height of twelve feet, ſhooting into many upright, ſlender, ſtiff branches, covered with whitiſh ſmooth bark, ſet alternately with ſmall evergreen ſerrated leaves, reſembling thoſe of *Alaternus*. Its flowers are ſmall, white, and grow promiſcuouſly amongſt the leaves, and are ſucceeded by ſmall ſpherical berries on ſhort footſtalks: theſe berries turn red in *October*, and remain ſo all the winter, which, with the green leaves and white bark, make an elegant appearance. But the great eſteem and uſe the *American Indians* have for it, gives it a greater character. They ſay, that, from the earlieſt times, the virtues of this Shrub has been known, and in uſe among them, prepared in the manner they now do it, which is after having dried, or rather parched the leaves in a porrage-pot over a ſlow fire, they keep it for uſe: of this they prepare their beloved liquor, making a ſtrong decoction of it, which they drink in large quantities, as well for their health as with great guſt and pleaſure, without any ſugar or other mixture; yet they drink and diſgorge it with eaſe, repeating it very often, and ſwallowing many quarts. They have an annual cuſtom in the ſpring of drinking it with ceremony; the town having notice from the King or principal, the inhabitants aſſemble at the Town-houſe, having previouſly by fire purged their houſes of all their old furniture, and ſupplied them with new, the King is firſt ſerved with a bowl or conch-ſhell, never uſed before, of this emetick broth, by the next to him in eminence, and he by the next is ſerved; and ſo on, till he comes to the women and children. They ſay it reſtores loſt appetite, ſtrengthens the ſtomach, giving them agility and courage in war, *&c.* It grows chiefly in the maritime parts of the country; from whence thoſe *Indians* ſupply the *Mountain-Indians* with it; carrying on the like trade with it in *Florida*, as the *Spaniards* do with the South-ſea tea from *Paraguay* to *Buenos-ayres*; *Florida* being in the ſame latitude north, as *Paraguay* is ſouth: and obſerving, by comparing the leaves of both, no apparent difference in them, induces me to believe they are both the ſame Plant. In *South-Carolina* it is called *Caſſena*. In *Virginia* and *North-Carolina* it is known by the name of *Yapon*; in the latter of which places it is as much in uſe among the white people as among the *Indians*, at leaſt among thoſe who inhabit the ſea-coaſts.

*CET Arbriſſeau s'éleve ordinairement à la hauteur de douze piés, avec pluſieurs tiges, qui ſe diviſent en pluſieurs branches menues, roides, couvertes d'une écorce liſſe & blanchâtre, & garnies de petites feuilles dentelées, toujours vertes, rangées alternativement, & ſemblables à celles de l'*alaterne. *Ses fleurs ſont petites, blanches, & viennent çà & là parmi les feuilles. Il leur ſuccede de petites bayes ſphériques, attachées à des pédicules courts: ces bayes deviennent rouges au mois d'*Octobre, *& demeurent en cet état tout l'Hiver, ce qui, joint au verd des feuilles & à la blancheur de l'écorce, produit un effet très agréable; mais le mérite de cet Arbriſſeau eſt encore plus relevé par l'eſtime que les* Américains *ont pour lui, & l'uſage qu'ils en font: ils diſent que ſes vertus ont été connues parmi eux depuis les prémiers temps, & qu'ils s'en ſont ſervis en le préparant de la même maniere qu'ils le font aujourd'hui: ce qui ſe fait en ſéchant, ou plutôt en grillant ſur un petit feu dans un pot les feuilles que l'on veut garder: ils font de ces feuilles une forte décoction, qui eſt leur breuvage favori, dont ils boivent une grande quantité autant par plaiſir & par goût, que pour leur ſanté: ils n'y mêlent ni ſucre ni autre choſe; & ils en avalent pluſieurs pintes, qu'ils vomiſſent avec la même facilité, ce qu'ils repetent ſouvent. Ils ont une coûtume annuelle au Printemps de boire cette liqueur en cérémonie: la ville étant avertie par le Roi ou le Chef, les habitans s'aſſemblent à la maiſon de ville, après avoir purgé leurs maiſons de tous leurs vieux meubles, & les avoir garnies de nouveaux utenſiles: le Roi reçoit le prémier dans un vaiſſeau ou une coquille, qui n'a jamais ſervi, cette liqueur émétique des mains du plus qualifié après lui: celui là eſt ſervi par un autre; & on va ainſi de ſuite juſqu'aux femmes & aux enfans. Ils diſent que ce bouillon retablit l'appetit, fortifie l'eſtomac, & leur donne de l'agilité & du courage à la guerre,* &c. *Il croît le plus communément dans les endroits du pays qui ſont vers la Mer; & les Indiens, qui les habitent, en fourniſſent à ceux des Montagnes: ils en font le même commerce à la* Floride, *que les Eſpagnols font du thé de la Mer du Sud, depuis le* Paraguai *juſqu'à* Buenos-Ayres. *La* Floride *étant dans la même latitude au Nord, que le* Paraguai *eſt au Sud, & ne trouvant aucune différence entre les feuilles de l'un & de l'autre, je ſuis porté à croire que c'eſt la même Plante. On la nomme au Sud de la* Caroline Caſſena: *à la* Virginie, *& au Nord de la* Caroline *elle eſt connue ſous le nom d'*Yapon; *& dans le dernier de ces endroits elle eſt autant en uſage parmi les* Blancs *que parmi les habitans, du moins ceux qui demeurent ſur la côte.*

Ilex vomitoria and, as such, must be taken into account.

At first glance, it would seem that *Cassine Paragua* Mill. might properly be the basis of a new combination under *Ilex*. Closer examination will reveal, however, that its status is that of a homonym with an orthographic variation and is, therefore, unavailable.

In the 9th edition of Miller's "Gardener's Dictionary" (1797) *Cassine* No. 2, the orthography is altered from *Cassine Paragua* to conform with Linnaeus' *C. Peragua*. Thomas Martyn, editor of the work, reported under *Cassine* No. 2, that: "*Cassine Paragua* of Miller is *Ilex vomitoria*. *C. Peragua* of the Mantissa, is *Viburnum laevigatum*." Martyn, having corrected Miller's orthographic error, united two names for the Old World concept correctly under the older name *Cassine Peragua*. But he then proceeded to misapply this name to the New World concept which we now know as *Ilex vomitoria* which is "native of Virginia and Carolina." In consideration of these circumstances, then, Miller's specific epithet *Paragua* cannot be available for transfer to *Ilex*.

The confused use of the name *Ilex Cassine*, which has likewise hampered our understanding of *Ilex vomitoria*, is attributable to the unfortunate fact that this binomial has been published by two authors for different concepts.

The earlier *Ilex Cassine* Linnaeus (Sp. Pl. (1753) 125) was an unfortunately chosen name, for while the binomial itself refers without any doubt to the dahoon of the southeastern United States, the specific epithet was taken from one of the common names of the yaupon holly and applied to the other holly by Linnaeus in error. *Ilex Cassine* L., therefore, is the accepted technical name for the dahoon holly.

A few years later, Walter (Fl. Carol. (1788) 241) published *Ilex Cassine* to refer to the concept we now call *I. vomitoria*, as ascertained by reference to a photograph

of the type specimen (Schubert [photographer]: "The Herbarium of Thomas Walter at the British Museum (Natural History), South Kensington, London, England," (1946–7) *Ilex Cassine* [a bound volume of photographs in the Gray Herbarium]). Although Walter's specific epithet is correctly applied to the plant which is widely known by that common name, and although it antedates *Ilex vomitoria* by one year, the name falls because it is a homonym.

This dual use of the same binomial has, as Loesener (in Bot. Centralbl. 47 (1891) 161–163) pointed out, led to confusion, although even a rapid examination of the case would have made clear all points of uncertainty. E. M. Hale's very excellent historical treatment of the black-drink plant ("*Ilex Cassine*, the aboriginal North American tea": Bull. No. 14, U.S.D.A. Div. Bot. (1891)), for example, suffers from his use of the name *Ilex Cassine* without even one reference to indicate whether the binomial of Linnaeus or that of Walter is being accepted; Hartwich's monumental work on narcotic plants ("Die Menschlichen Genussmittel" (1911) 468) uses *Ilex Cassine* L.; and Wehmer ("Die Pflanzenstoffe" (1911) 456; [ed. 2] 2 (1931) 718) accepts *I. Cassine* Walt. The first chemical report (Smith, H. M.: in Am. Journ. Pharm. 44 (1872) 216) of the discovery of caffeine in a North American *Ilex* is of doubtful value partly because of an uncertainty as to which *Ilex Cassine* was being examined. In 1883, still another report of a chemical analysis (Venable, F. R.: in Chem. News 52 (1885) 172) employed the name *Ilex Cassine* without author citation, thus leaving room for uncertainty as to the exact species which was analysed. An even more interesting result of the confusion of the *Ilex Cassine* of Linnaeus with that of Walter is found in a standard pharmacological work (Tschirch, A.: "Handbuch der Pharmacognosie" 3,

Abt. 1 (1923) 432), in which its writer "affirms and denies the existence of caffeine in *Ilex Cassine* all in the same paragraph" (Maxwell, M. M.: "*Ilex Cassine* L. . . ." ms. report (no date) in Libr. Econ. Bot. Harvard Univ.).

Loesener (in Bot. Centralbl. 47 (1891) 163) rejects *Ilex vomitoria* in favor of *Ilex caroliniana* (Lam.) Loes., a combination which he made on the basis of Lamarck's *Cassine caroliniana*. This procedure is not permissible. Lamarck's binomial *Cassine caroliniana* (1783) is not available, since it is a substitute for the validly published *Cassine corymbosa* Miller (Dict., [ed. 8] (1768) *Cassine* No. 1; Icones (1760) 83, t. 1). It might be pointed out in passing that Miller's *Cassine corymbosa* does not refer to the concept *Ilex vomitoria*.

The other synonyms of *Ilex vomitoria* have not, for the most part, entered into the chemical, pharmacological and anthropological literature. They are included in the foregoing enumeration for the sake of completeness. Several of the Rafinesque names are referred to *Ilex vomitoria* with some reserve. They are not based on specimens which might be examined, and the descriptions are brief and vague in the extreme. It is fortunate that they do not need to be considered nomenclatorially in determining the correct name of the yaupon, but, being later, can be relegated immediately to synonymy.

A NEW VARIETY OF ILEX VOMITORIA FROM SOUTHERN MEXICO[1]

BY
A. J. SHARP

Ilex vomitoria [*Soland.* in] *Aiton* var. **chiapensis** *A. J. Sharp var. nov.*

Haec variatas ab *Ilice vomitoria* principaliter foliis pubescentibus et ramulorum villis longioribus differt.

From the species, this new variety differs primarily in having loosely pubescent leaves and longer (about twice as long) hairs on the branchlets. There is a tendency for the leaves to be a little more ovate and obtuse at the apices, although many leaves match in shape those from North American material of the species. The material of *Ilex vomitoria* in the Gray Herbarium (all from southeastern United States) has been examined, and the leaves are glabrous, except for occasional puberulence on the mid-rib at the base.

This report adds another species to the growing list of plants which occur both in central or southern Mexico and in southeastern United States. In Mexico, their ranges are disjunct from their areas in the United States, and the largest number of such species seems to be found in the highlands toward the Gulf of Mexico. A fuller discussion of the phytogeographical problem basic to this interrupted distribution will be presented later.

[1] Contribution from the Botanical Laboratory, The University of Tennessee, N.S. 118.

MEXICO: Estado de Chiapas, south side of Río Tzaconeja near San Gregorio. Alt. 6500 ft. November 20, 1945, *Aaron J. Sharp & Efraín Hernández Xolocotzi 45989*. (TYPE in Herb. Gray; DUPLICATE TYPES in Herb. Univ. Tenn., Herb. Inst. Biol. (México)).—Estado de Chiapas, near Lake Jusnajav, about 16 km. northeast of Comitán. Alt. 5500 ft. April 29, 1945, *Aaron J. Sharp & Edward J. Alexander 45444*. —Estado de Chiapas, moist slope below Morelia, toward Río Tzaconeja, on the trail to San Carlos. Alt. 4600 ft. April 10, 1946, *Efraín Hernández Xolocotzi & Aaron J. Sharp 46249*.

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PLANTAE AUSTRO-AMERICANAE VI
PLANTARUM PRINCIPALITER VALLIS AMAZONIAE NOVARUM VEL MINUS COGNITARUM NOTAE DIVERSAE

BY

RICHARD EVANS SCHULTES[1]

RECENT work on a number of South American plant collections, for the most part of Amazonian origin, has uncovered several novelties and has provided us with additional information of a phytogeographical or ethnobotanical nature. The following notes are offered as a contribution to our knowledge of this interesting part of the New World.

I am grateful to a number of my botanical colleagues for their determination of plants in certain groups: Dr. L. H. Bailey and Dr. H. Emery Moore (Palmae); Dr. Robert Woodson (Apocynaceae); Dr. José Cuatrecasas (Chloranthaceae, Moraceae, and Musaceae); Dr. Harold N. Moldenke (Menispermaceae); and Dr. Bassett Maguire (Rapateaceae). It is also a pleasure to express my appreciation to Mr. Elmer W. Smith for his beautiful and highly accurate drawings of several of the newly described species. The drawings of the concepts of *Herrania* were made possible by a grant from the American

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Cocoa Research Institute, for which my sincere thanks are due.

Triuridaceae

Soridium Spruceanum *Miers* in Proc. Linn. Soc. 2 (1850) 75.

Although rare in collections, *Soridium Spruceanum*, the type of which was from Pará, is not uncommon in the upper Rio Negro basin.

Brazil: Estado do Amazonas, Rio Uaupés, Taracuá. January 28–February 9, 1948, *Richard Evans Schultes & Francisco López 9681A*.

Palmae

Bactris balanophora *Spruce* in Journ. Linn. Soc. 11 (1871) 146, 153.

Bactris balanophora was described from material gathered by Spruce from San Carlos on the upper Río Negro in Venezuela. The collection cited below places the concept for the first time well within the Amazonian area of Colombia and very greatly extends the known range of the plant.

Colombia: Comisaría del Amazonas, Río Igaraparaná, vicinity of La Chorrera. "Leaf and petiole 9 feet long. Plant 12–15 feet tall." June 4–10, 1942, *Richard Evans Schultes 3938*.

Chamaedorea integrifolia (*Trail*) *Dammer* in Verhandl. Bot. Ver. Brandenburg 48 (1907) 125.

This small palm is apparently new to the flora of Colombia.

Colombia: Comisaría del Amazonas, Río Loretoyacu. Alt. about 100 m. October 20–30, 1945, *Richard Evans Schultes 6626*.

Chamaedorea lanceolata (*Ruiz & Pav.*) *Kunth* Enum. Pl. 3 (1841) 172.

Chamaedorea lanceolata is herewith reported, apparently for the first time, from Colombia.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. Alt. about 100 m. "Fruit ripening orange." October 20–30, 1945, *Richard Evans Schultes 6603*.

Geonoma interrupta (*Ruiz & Pav.*) *Martius* Hist. Nat. Palm. 2 (1823) 8, t. 7.

According to Dugand's enumeration of palms found in Colombia (in Caldasia 1 (1940) 44–48), this species of *Geonoma* has never before been recorded.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. Alt. about 100 m. "Twelve feet tall." October 20–30, 1945, *Richard Evans Schultes 6749*.

Geonoma laxiflora *Martius* Hist. Nat. Palm. 2 (1823) 12, t. 11.

Geonoma laxiflora, an Amazonian species, is now recorded as an element of the flora of Colombia.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. Alt. about 100 m. "Small palm. In clumps, 12–15 ft. tall. Tikuna name = *bĕ-ee-chá*." October 20–30, 1945, *Richard Evans Schultes 6656*.

Geonoma pycnostachys *Martius* Hist. Nat. Palm. 2 (1823) 16, t. 17.

Described from material collected by Martius in the Caquetá of Colombia, *Geonoma pycnostachys* is now registered from the headwaters of the Río Putumayo. Since the locality cited below is exactly on the boundary between Colombia and Ecuador, this species should likewise be assigned to the flora of Ecuador.

COLOMBIA: Comisaría del Putumayo, Río San Miguel or Sucumbíos, Santa Rosa and vicinity. "Small terrestrial plant. Kofán Indian name: *tsau-hess*." April 1942, *Richard Evans Schultes 3547*.

Lepidocaryum tenue *Martius* Hist. Nat. Palm. 2 (1823) 51, t. 47.

Dugand (loc. cit. 31) enumerates only two species of *Lepidocaryum* from Colombia. *Lepidocaryum tenue*, fre-

quent in Amazonian Brazil, is, however, now definitely reported from Colombia.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, between El Encanto and the mouth. Alt. about 150 m.? "Stems used in basketry." May 22–28, 1942, *Richard Evans Schultes 3851*.

Parascheelia anchistropetala *Dugand* in Caldasia 1 (1940) 12, t. 4, 5.

Schultes 5856 is topotypical and represents the second collection of this interesting savanna palm.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, savanna at base of Cerro Circasia. "Inflorescence basal. Leaf 6–7 feet long with 72″ leaflets." March 7, 1944, *Richard Evans Schultes 5856*.

RAPATEACEAE

Rapatea longipes *Spruce ex Körnicke* in Linnaea 37 (1871–72) 472.

Spruce collected the type of *Rapatea longipes* at "Panuré" on the Rio Uaupés. The collection cited below is topotypical.

BRAZIL: Estado do Amazonas, Rio Uaupés, Ipanoré. "Bracts of inflorescence red." November 14–15, 1947, *Richard Evans Schultes & João Murça Pires 9079*.

Rapatea modesta *Maguire sp. nov.*

Herbae parvae acaulescentes perennantes. Folia 3–6, 20–50 cm. longa; vaginis valde equitantibus distichisque; in uno plano dispositis, submembranaceis, vel tenuiter chartaceis, late rotundatis, nervis distinctis ca. 40 munitis, 1.8–2.5 cm. e costa ad marginem, (4–) 5–9 cm. longis; petiolis (7–) 10–30 cm. longis, ca. 2.4 mm. crassis, apicem versus anguste alatis; laminis tenuiter chartaceis, 8–15 cm. longis, 3–5 cm. latis, oblongo-ellipticis, nervis primariis 15–20 (–30), apice subconduplicato, abrupte caudato-acuminato, obtuso, 15–20 mm. longo, basi abrupte constricta, inaequilaterali. Pedunculus pseudo-

terminalis, solitarius, 10–30 cm. longus, 2–2.5 mm. crassus, ad apicem paullum dilatatus compressusque, apicem versus castaneo-furfuraceus, demum glabrescens. Inflorescentia compressa; involucri bracteis 2, reniformi-caudatis, 2.5–3.5 cm. longis, 2.5–3 cm. latis, tenuiter multinervatis, albidis, ad basim castaneo-furfuraceis, apice 1–2.5 cm. longo; receptaculo convexo, ca. 6 mm. lato, 4 mm. alto, bracteis paleaceis; spiculis sessilibus, bracteolis 8–10, lineari-oblanceolatis, 9–10 mm. longis, 1–2 mm. latis, trinervatis, membranaceis, sub calyce approximatis, abrupte acuminatis, acumine 1.5–2 mm. longo. Sepala 3, ca. 10 mm. longa, indistincte 3–5 nervata, ad basim delicate membranacea in tubum connata, sursum libera lanceolato-acuminata, indurata; corolla delicate membranacea, alba ut videtur, ca. 10 cm. longa, ad basim per 1–2 mm. ad corollam adnata, laminis ovato-deltoideis, acutis, ca. 5 mm. longis; staminibus 6, ca. 6 mm. longis; filamentis membranaceis, 1–2 mm. longis, 0.8–1 mm. latis; antheris ca. 4 mm. longis, quadrilobatis in sectione transversali, ad basim auriculatis sursum arctantibus, albis ad apicem vix castaneo-furfuraceis; appendice ca. 1.5 mm. longa, castanea, cochleariformi, lineari-oblonga, e basi brevi sigmoidea oriente; stylo plusminusve stamina aequante, stigmate trigono, acuto; ovario triloculari, ad basim membranaceo, sursum subindurato, albo; ovulum unum in loculo; semine oblongo, 5–6 mm. longo, 3–3.5 mm. lato, integumento interiore denso, saturate castaneo, longitudinaliter striato, striis manifestis per integumentum exterius albidum translucens ad apicem disjunctum et bulbosum, ad hilum densum et oblique concavum.

Small acaulescent perennial herbs. Leaves 3 to 6, 20–50 cm. long; sheaths strongly equitant and distichous, disposed in a single plane, sub-membranaceous or thinly chartaceous, broadly rounded, with about 40 distinct

nerves, 1.8–2.5 cm. broad from midrib to margin, (4) 5–9 cm. long; petioles (7) 10–30 cm. long, about 2.5 mm. thick, narrowly winged toward the apex: blades thinly chartaceous, 8–15 cm. long, 3–5 cm. broad, oblong-elliptic, with 15–25 (30) primary veins, the apex sub-conduplicate, abruptly caudate-acuminate, obtuse, 15–20 mm. long, the base abruptly constricted, inequalateral. Peduncle pseudo-terminal, solitary, 10–30 cm. long, 2 2.5 mm. thick, somewhat enlarged and compressed at the summit, brown-scurfy-pubescent upward, at length glabrescent. Inflorescence compressed. Involucral bracts 2, reniform-caudate, 2.5–3.5 cm. long, 2.5–3 cm. broad, finely multi-veined, whitish and brown-scurfy at the base, the apex 1–2.5 cm. long. Receptacle convex, about 6 mm. broad, 4 mm. high, bracts paleaceous. Spikelets essentially sessile, bractlets 8–10, linear-oblanceolate, 9–10 mm. long, 1–2 mm. broad, 3-nerved, membranaceous, abruptly acuminate, the acumen 1.5–2 mm. long, the bractlets approximately arranged below the calyx. Sepals 3, about 10 mm. long, faintly 3–5-veined, the bases delicately membranous and completely connate into a tube, the upper halves free, lanceolate-acuminate, indurate. Corolla delicately membranous, white, apparently about 10 cm. long, the claws connate for 1–2 mm., the blade ovate-deltoid, acute, about 5 mm. long. Stamens 6, about 6 mm. long; filaments membranous, 1–2 mm. long, 0.8–1 mm. broad, adnate to the corolla for 1–2 mm.; anthers about 4 mm. long, 4-lobed in cross section, auriculate at the base tapering upward, white, scantily brown-scurfy at the summit; appendage about 1.5 mm. long, brown, cochleariform, linear-oblong, attached by a short, sigmoid base. Style more or less equalling the stamens, the stigma trigonous, acute. Ovary 3-celled, membranous at the base, the upper part subindurate, white; ovules 1 per cell. Seed oblong, 5–6 mm.

long, 3–3.5 mm. broad, the inner integument dense, dark brown, longitudinally striate, the striae visible through the whitish translucent outer integument which becomes separated and bulbous at the apex, and dense and obliquely concave at the hilum.

Doctor Maguire writes me, in connection with his description of *Rapatea modesta*, that: "*Rapatea modesta* is most closely related to *R. longipes* Spruce ex Körnicke, from which it differs in its smaller habit, broader, shorter, and more conspicuously veined membranous leaf-sheaths, relatively broader and more numerously veined leaf-blades, considerably larger heads, more acuminate spiked bractlets, and white rather than yellow flowers.

"These two species are to be associated in habitat and range. *Rapatea modesta* occurs in sand savannahs in the *trapécio* region between the Putumayo and Amazon watersheds in southeastern Colombia. The four collections of *Rapatea longipes* which I have examined are from the region of the upper Rio Negro in Brazil, Colombia and Venezuela.

"The epithet *modesta* was suggested by the collector's comment that this attractive and distinct little *Rapatea* appealed to him in the field as a shy, almost retiring, but lovely member of the caatinga community."

COLOMBIA: Comisaría del Amazonas, Trapécio amazónico, interior regions of trapécio between the Amazon and Putumayo watersheds. Alt. above 100 m. November 1945, *Richard Evans Schultes 6900* (TYPE in N.Y. Bot. Gard.).—Same locality, November 1946, *George A. Black & Richard Evans Schultes 46-361.*

Rapatea modesta has a red-flowered form which grows promiscuously with the white color-form. Red flowers have not hitherto been reported for the genus.

COLOMBIA: Comisaría del Amazonas, Trapécio amazónica, interior regions of trapécio between the Amazon and Putumayo watersheds. Alt. above 100 m. "Same as 6900, except flowers red." November 1945, *Richard Evans Schultes 6899.*

Rapatea Spruceana *Körnicke* in Linnaea 37 (1871-73) 470.

Rapatea Spruceana has apparently not hitherto been reported for the flora of Colombia. The type was collected by Spruce along the lower Río Guainía, possibly on the Colombian side. *Schultes & López 9297* may be considered as topotypical.

COLOMBIA: Comisaría del Vaupés, Río Negro, El Castillo, San Felipe (opposite San Carlos, Venezuela). "Flowers yellow." December 12, 1947, *Richard Evans Schultes & Francisco López 9297*.

MUSACEAE

Heliconia lingulata *Ruiz & Pavon* Fl. Peruv. et Chil. 3 (1802) 71.

Known from the Departamento del Valle in Colombia, *Heliconia lingulata*, through the collection here cited, is now recorded from the Colombian Amazon watershed.

COLOMBIA: Departamento del Cauca, Puerto Limón, "Bracts rose-coloured. *Platanillo.* Leaves 12 feet long. Inflorescence 6 feet long." February 28, 1942, *Richard Evans Schultes 3351*.

Heliconia psittacorum *Linnaeus filius* Suppl. (1781) 158.

Heliconia psittacorum is widespread in the northern tropical parts of South America; in Colombia, it has been collected from the Llanos, from Santander, and from the Vaupés basin. *Schultes 6633* is apparently the second collection from the Colombian Amazonia and greatly extends the known range of the species in that area.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Bracts red with tips green. *Capavira.*" October 20–30, 1945, *Richard Evans Schultes 6633*.

Heliconia Schumanniana *Loesener* in Engl. Bot. Jahrb. 54, Beibl. 117 (1916) 12.

Heliconia Schumanniana, the type of which came from

eastern Perú, has apparently not previously been recorded from Colombia.

COLOMBIA: Comisaría del Putumayo, Río Caucaya, entre Puerto Jaramillo y el Río Putumayo. Altitude about 225 m. May 16, 1942, *Richard Evans Schultes 3711*.

Heliconia stricta *Huber* in Bol. Mus. Goeldi 4 (1906) 543.

Heliconia stricta was described from material collected in Perú. *Schultes 3489*, from the boundary of Colombia and Ecuador, is apparently the first collection of the species from either of these countries.

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos (San Miguel) Puerto Conejo. "*Platanillo.*" April 2–5, 1942, *Richard Evans Schultes 3489*.

CHLORANTHACEAE

Hedyosmum toxicum *Cuatrecasas* in Caldasia 3 (1945) 432.

Hedyosmum toxicum is very seldom used as a medicine and always with great care, and it is never taken as a beverage. Unless the decoction of the leaves be made rather weak, it can act as a violent emetic and is a strong intoxicant.

COLOMBIA: Comisaría del Putumayo, Páramo de San Antonio, altitude about 3000 m. "*Granisillo pequeño.* Large tree. Leaves aromatic. A tea of leaves sometimes used as a stomach tonic and as purge. It is a strong emetic." February 13, 1942, *Richard Evans Schultes 3249*.

Hedyosmum translucidum *Cuatrecasas* in Caldasia 3 (1945) 436.

A remarkable tonic-stimulant effect is noted immediately after a draught of a very hot decoction of the leaves of *Hedyosmum translucidum*. It may contain an active stimulant. During plant-collecting trips in the high, cold páramos of the western part of the Comisaría del Putumayo, I often prepared from the leaves of this bush, *granisillo*, the delicious aromatic beverage which travel-

lers in these high, inhospitable regions have learned to employ as a stimulant.

COLOMBIA: Comisaría del Putumayo, Páramo de San Antonio, altitude about 3000 m. "*Granisillo del grande.* Leaves aromatic. Tea of leaves used occasionally as a beverage and medicinally for stomach upsets." February 13, 1942, *Richard Evans Schultes 3221*.

MORACEAE

Cecropia latiloba *Miquel* in Martius Fl. Bras. 4, pt. 1 (1853) 147.

Known from Brazil and possibly Perú, *Cecropia latiloba* seems not to have been previously reported as a component of the Colombian flora.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Small tree." October 20–30, 1945, *Richard Evans Schultes 6720.*—Same locality. "Small tree." November 1945, *Richard Evans Schultes 6912.*

Cecropia telealbida *Cuatrecasas* in Rev. Acad. Colomb. Ciénc. 6 (1945) 294, t. 2, fig. 6.

The type of *Cecropia telealbida* was collected in southern Huila at a much higher altitude (1850 m.) than the two collections cited below.

COLOMBIA: Departamento del Huila, Río Villalobos, Quebrada Guayabo, altitude 1400–1450 m. January 1943, *Richard Evans Schultes & M. Villarreal 5172.*—Departamento del Huila, Río Villalobos, region of the confluence of Ríos Villalobos and Cauchos. Altitude 1400 m. January 1943, *Richard Evans Schultes & M. Villarreal 5205.*

Cecropia telenivea *Cuatrecasas* in Rev. Acad. Colomb. Ciénc. 6 (1945) 295.

This second collection of *Cecropia telenivea* is topotypical.

COLOMBIA: Comisaría del Putumayo, Valle de Sibundoy, Sibundoy, hills north of town, altitude about 2250 m. "Large tree." February 18, 1942, *Richard Evans Schultes 3275.*

Cecropia tolimensis *Cuatrecasas* in Rev. Acad. Colomb. Ciénc. 6 (1945) 282, t. 1, fig. 4, t. 2, fig. 5.

Cecropia tolimensis was described from material from Tolima, much to the north of the Huila locality of *Schultes & Villarreal 5128* which represents the second collection of the species to be reported.

COLOMBIA: Departamento del Huila, Pitalito, Calamo, open fields. Altitude about 1300 m. December 30, 1942, *Richard Evans Schultes & M. Villarreal 5128*.

Coussapoa intermedia *Martius ex Miquel* in Martius Fl. Bras. 4, pt. 1 (1853) 133.

Coussapoa intermedia, hitherto known from Amazonian Perú and Brazil, is now recorded for the flora of Colombia.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Large tree." October 20–30, 1945, *Richard Evans Schultes 6726*.

Coussapoa magnifolia *Trécul* in Ann. Sci. Nat., ser. 3, 8 (1847) 98.

Although *Coussapoa magnifolia* is known from eastern Perú, I have been unable to find other collections of this species from Colombia.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Epiphyte." October 20–30, 1949, *Richard Evans Schultes 6693*.

OLACACEAE

Heisteria cyanocarpa *Poeppig & Endlicher* Nov. Gen. ac Sp. 3 (1845) 35, t. 241.

In Macbride's "Flora of Peru" (Field Mus. Publ. Bot. 13, pt. 2, no. 2 (1937) 423), Standley gives, as the distribution of this species, eastern Perú and Amazonian Brazil. Apparently it has not been recorded as an element of the Colombian flora, although it is frequent in the southern part of the Colombian Amazonia. Several of the collections cited as Peruvian, however, are actually from Colombian territory and attest the frequency of this shrub, especially in the *trapécio amazónico*. *Ll.*

Williams 2745, *2805*, *2808*, *2949* (from La Victoria) and *3169* (from Leticia) are Colombian.

Similarly, *Heisteria curycarpa* Standl., known only from the type collection made at La Victoria, near Leticia, Colombia, has been cited as Peruvian; although this concept undoubtedly occurs on the Peruvian as well as on the Colombian side of the Amazon River, it is advisable to include it in an enumeration of Colombian plants.

COLOMBIA: Comisaría del Amazonas. Trapécio amazónico, Loreto-yacu River. Alt. about 100 m. "Bush. Bracts red." October 1945, *Richard Evans Schultes 6832*.

MENISPERMACEAE

Sciadotenia toxifera *Krukoff & Smith* in Bull. Torr. Bot. Club 66 (1939) 308.

Sciadotenia toxifera has previously been known from Amazonian Ecuador where Richard C. Gill collected it as an ingredient of the curare of the Canelos Indians of the Napo-Pastaza area. This was the first report of the genus as an arrow poison plant (Krukoff & Smith loc. cit.).

The Witoto Indians of Amazonian Colombia no longer prepare curare, but knowledge of which plants entered into their poisons is still extant. *Sciadotenia toxifera* was indicated as one of the principal ingredients.

COLOMBIA: Comisaría del Amazonas, Karaparaná, El Encanto. "Bush in swamps. Fruit with soft brown hairs but with a blue-green sheen through indumentum. Height 8 ft. Witoto name: *he̯-de̯-ká-pe̯*. Formerly used to make arrow poisons, together with other plants." May 23, 1942, *Richard Evans Schultes 3866*.

STERCULIACEAE

Herrania Camargoana *R. E. Schultes sp. nov.*

Arbuscula parva, tenuis gracilisque, vulgo plusminusve octo vel decem (sed saepe usque ad viginti septem) pedes alta; erecto cum trunco tereti, circiter 4–5 pollices in

diametro, nigro cum cortice obtecta; prope trunci apicem parce ramosa; ramis tomentosis sed mox glabratis. Ramuli dense villosi, ferrugineis cum pilis, subglabrescentes. Folia amplissima, digitata, sex- ad novem-foliata, longissime petiolata. Petioli teretes, basi valde constricti, molliter aureo-ferrugineo-tomentelli, usque ad 60 cm. longi, 10 mm. in diametro. Stipulae persistentes, subulatae, densissime tomentellae, usque ad 3 cm. longae. Foliola sessilia, oblanceolata vel late lanceolato-ovata, leviter erecta, inaequalia, membranaceo-papyracea, apice acuminata, basi attenuata, margine dimidio superiore regulariter et conspicue sinuata, et omnino pilis vel pseudociliis stellatis armata, 60–75 cm. longa, 16–26 cm. lata, supra aspera, sparse pilosa cum pilis longis et solitariis, subtus submolliter tomentella cum pilis longis stellatis. Inflorescentiae fasciculatae, multiflorae, ex trunci omnibus partibus sed vulgo inferioribus prorumpentes. Pedicelli articulati, usque ad 28 mm. longi, 0.8 mm. in diametro. Alabaster floris globosus, usque ad 10 mm. in diametro, stellato-pilosus. Calyx trifidus, fere usque ad basim divisus, subcymbiformis. Sepala late elliptico-oblonga, apice subacuta, margine integra, extus atropurpurea, intus sanguinea, plusminusve 12 mm. longa, 8–9 mm. lata, intus glabra, extus stellato-pilosa cum pilis ferrugineis usque ad 1 mm. longis atque pilis albis minutissimis. Petala quinque, sessilia, obovato-rotundata, apice valdissime concavo-cucullata, circiter 8 mm. longa, 6 mm. lata, quinque cum nervis atropurpureis longitudinalibus atque nervulis reticulatis, alibi flava, extus conspicue muricato-verrucosa, superne in ligulam extensa. Ligulae lineares, plusminusve 90 mm. longae, basi 1.7 mm. latae, apice filiformes, basi ipsa sanguineae sed maxima pro parte albido-flavae. Tubus stamineus quinquedivisus cum staminibus diantheriferis et simplicibus cum filamentis brevibus liberisque. Ovarium ellipsoideum,

3.5 mm. longum, 2–2.5 mm. in diametro, densissime et grossiuscule albido-pilosum. Stylus teres, simplex, flavus, stigmate apice inconspicue quinquediviso, 3 mm. longus. Staminodia conspicua, rhomboideo-elliptica, apice obtusa, margine integra, utrinque verrucosa, cinereo-purpurea, 14 mm. longa, 5 mm. lata. Fructus numerosi, quasi globosi vel leviter ellipsoidei, apice abruptissime et longe apiculati (apicula 2–2.5 cm. longa), plusminusve 8–8.5 cm. longi, 3.5–4.5 cm. in diametro, basi attenuati, sepalis persistentibus cum pedunculo 3–4 cm. longo, 2.5 mm. in diametro, longitudinaliter decem-costati, cum costis primariis et secundariis subaequalibus, tenuibus cultriformibusque, altitudine irregularibus sed maxime pro parte (vivo) 5–6 mm. altis, transverse irregulariter sed conspicue costati cum costis cultriformibus, quam longitudinalibus paulo humilioribus vel saepe altioribus, in costarum longitudinalium et transversalium junctionibus projectionibus carnoso-mollibus mammoso-spiniformibus (quae apice aliquid hebetatae sunt) productis, in costis omnibus et multo sparsius inter costas pilis stellatis urticantibus armati; pericarpio crasso, maturitate rufo vel sanguineo; semina viginti quinque, obtuse rotundato-pyramidalia, circiter 9 mm. longa×11 mm. lata×7 mm. crassa, in pulpa alba inclusa.

Brazil: Estado do Amazonas, Rio Negro, Serra de São Gabriel. "Treelet 12 feet tall. Fruit globose. All ten longitudinal ribs about equal, sharp, transverse ribs as high or higher. Projections formed at juncture of longitudinal and transverse ribs long, upturned, soft, hispid, stinging hairs along ribs and to a lesser extent between. Ripening scarlet. Seeds 25." February 12, 1948, *Richard Evans Schultes & Francisco López 9722* (Type in Herb. Gray).—Estado do Amazonas, Rio Uaupés, between Ipanoré and confluence with Rio Negro, Serra Wabeesee, on left bank a little below Bela Vista. November 17, 1947, *Richard Evans Schultes & Francisco López 9144* (Type of flowers in Herb. Gray).—Estado do Amazonas, Rio Negro. "Encosta da Serra de Cabary a 450 m. de altitude. Arbusto de 5 metros." December 2, 1945, *Ricardo de Lemos Fróes 21468*.—Estado do Amazonas, Rio Negro, Uaupés (São Gabriel). "Mata sopé Serra São Gabriel. Arbusto

5 metros; flores ruges rubro.'' December 22, 1945, *Ricardo de Lemos Fróes 21540.*—Estado do Amazonas, Rio Negro, São Gabriel (Uaupés), Serra de São Gabriel, near summit. Alt. c. 100 m. "Single-trunked treelet up to 9 m. tall. Three or four leaves on top. Fruit clustered on stem, usually near base, three to four in each fascicle, almost globose with very abruptly pointed apex, main and secondary longitudinal ribs almost equal, but transverse ribs as high or higher than main ribs, forming upturned pseudoechinate projections at right angled point of juncture, hispid stinging hairs all along ribs and to lesser extent on surface of fruit. Ripening a scarlet. Seeds 25, embedded in acid, white pulp. Trunk 4–5 inches in diameter. Bark smooth, black. Leaflets curiously "spurred" at base, thickened spur causing them to be somewhat erect. Extremely common. Leaflets entire in lower half, regularly sinuate in upper half. *Cacao jacaré.* Tukano = *ee-só-pe-kĕ.*'' September 15, 1947, *Richard Evans Schultes & Francisco López 8758.*—Same locality and date. "Trunk black, columnar, 3 inches in diameter. Treelet 8 m. tall. Leaf lobes thickened at base into spur-like prong, throwing them upwards. Fruit on stem at 5 ft. above ground. Ripening red. Transverse and main ridges meet to form curious thickening in form of upturned 'hooks,' covered with stinging hairs.'' *Richard Evans Schultes & Francisco López 8759.*—Same locality and date. "Seven m. tall; diameter 3 inches. Bark black. Fruit ripens red. 25 seeds. Fruit looks softly echinate due to warty projections all over where transverse and horizontal ribs cross.'' *Richard Evans Schultes & Francisco López 8762.*—Same locality and date. *Richard Evans Schultes & Francisco López 8763.*—Estado do Amazonas, Rio Negro, Tapurucuara (Santa Isabel). September 11, 1947, *Richard Evans Schultes & Francisco López 8956.*—Estado do Amazonas, Rio Negro basin, Rio Padauiary. October 27, 1947, *Ricardo de Lemos Fróes 22673.*—Estado do Amazonas, Rio Negro, near São Gabriel, at base of Serra Uanari. October 31, 1947, *Richard Evans Schultes & João Murça Pires 8978.*—Estado do Amazonas, Rio Uaupés, Serra Wabeesee, below Bela Vista. "Flowers many in clusters. Calyx segments red, petals and staminodes greyish purple. Ligules greyish purple, 5–6 cm. long. Treelet 15 ft. tall.'' November 17, 1947, *Richard Evans Schultes & João Murça Pires 9130.*—Estado do Amazonas, Rio Negro, Serra de São Gabriel. "Treelet 8 ft. tall. Flowers in many-flowered fascicles. Sepals externally dark blood-red, internally scarlet; petals ashy red with yellow stripes; staminodes ashy purple-red, internally showing white-yellow patches, externally dark red. Ligules 8–9 cm. long, linear, externally red, internally white-yellow, but folded or inrolled so that red is enclosed. Tukano: *ö-só-pee-kö.*'' November 20–25, 1947, *Richard Evans Schultes & Francisco López 9162.*—Estado do Amazonas, Rio Negro, mouth of Rio Xié. December 2, 1947, *Richard Evans Schultes & Francisco López 9205.*—Estado do Amazonas, Rio Negro, Nazaré. "Treelet 15 ft.

tall. Trunk 4 inches in diameter. Fascicles with up to 30 flowers. Flowers dull ash-purple with exterior of sepals scarlet and most of length of infolded ligules a faintly purplish white. Buds perfectly globose. Bark nearly black. Leaves few. Leaflets unevenly lanceolate. Fruit 'spiny,' apically very long acuminate. *Cacao de jacaré.*'' December 5, 1947, *Richard Evans Schultes & Francisco López 9240.*—Estado do Amazonas, Rio Negro, Serra de São Gabriel. ''Small treelet, 12 feet tall.'' January 14, 1948, *Richard Evans Schultes & Francisco López 9619.*—Estado do Amazonas, Rio Negro, Serra Jacamín. ''Small treelet about 12 feet tall. Trunk slender, 3–4 in. in diameter, bark thin, smooth, black. Leaves large, hairy, upper half of leaflets sinuate. *Cacao de macaco.*'' March 27, 1948, *Richard Evans Schultes & Francisco López 9747.*—Estado do Amazonas, Rio Negro between São Felipe and Karapaná. May 4, 1948, *Richard Evans Schultes & Francisco López 9869.*

Herrania Camargoana is named in honor of Dr. Felisberto Camargo, founder and director of the Instituto Agronômico do Norte in Belém do Pará, Brazil. Possessed of a deep patriotism and a fervent desire to take the benefits of agronomical science to the poor and forgotten *caboclo* of the Amazon valley, Camargo has, at times almost single-handedly, carried out an energetic crusade to improve the lot of the Amazon through better agriculture. In spite of discouraging odds in the form of tremendous distances, primitive transportation and actual lack of geographical knowledge of large areas; and of poverty, sickness, apathy and lack of education amongst the people themselves, the efforts of Camargo and his small but loyal group of scientists are beginning to bear real fruit. To the best of my knowledge, this program, embracing many phases of fundamental biological research (from plant exploration and introduction to forest tree breeding and phytopathology) and the establishment of nurseries and plantations, constitutes the only sustained agricultural work of a truly scientific nature which the Amazon has seen in the four centuries since its discovery by Europeans.

Restricted apparently to the uppermost Rio Negro basin, *Herrania Camargoana* seems to have as its closest

ally the Guianan and Venezuelan *H. lemniscata*. This relationship is strikingly evident when one compares the fruits of the two concepts. Both species have relatively small capsules in which there are transverse ribs nearly as large as the cultriform longitudinal ribs, and soft, pointed mammoid projections at each junction of the longitudinal and transverse ribs. The former species, however, has much longer and upturned projections than the latter, and would seem, in this as in some other characters, to represent an extreme in the evolution of the genus. There would appear to be a rather easily traceable trend from *Herrania Mariae* through *H. lemniscata* to *H. Camargoana*, on the one hand, and to *H. laciniifolia* on the other.

The coloration of the flowers of *Herrania Camargoana* and *H. lemniscata* is similarly complex and also indicates a relationship. No other known species of *Herrania* can match these two for complexity of floral coloration. *Herrania Camargoana*, according to field notes quoted in detail above, has sepals which are dark blood-red externally but scarlet internally; petals which are ashy red or purple with yellowish stripes; staminodes which are ashy purple-maroon with white-yellow patches internally but entirely dark red externally; and ligules, red without and white-yellow within, which are folded or inrolled, so that the red is enclosed and is not seen directly. *Herrania lemniscata* has, according to field notes (*Steyermark 60558*), sepals which are white in the uppermost two-thirds and rose-salmon below, with rose stripes; and staminodes (called "petals" on the label) which are dull yellow with dull rose specks in the lower half.

The shape and size of the leaflets, however, differ strikingly in the two concepts. *Herrania Camargoana* has oblanceolate or broadly lanceolate-ovate leaflets which measure 60–75 cm. in length and 16–26 cm. in

width with the upper half regularly and conspicuously sinuate. *Herrania lemniscata* has leaflets which are at least 80 cm. long and 40 cm. wide with the margin very deeply pinnatilobate with usually four irregular, for the most part widely triangular or widely lanceolate-acuminate segments, each up to 18 cm. long and 9–10 cm. wide.

Herrania kanukuensis *R. E. Schultes* in Caldasia 2 (1943) 11; in Bot. Mus. Leafl. Harvard Univ. 13 (1949) 277.

Hitherto known only from the type collection from the Kanuku Mountains in adjacent British Guiana, *Herrania kanukuensis* is now registered, through the collection cited below, from northern Amazonian Brazil.

Inasmuch as *Herrania kanukuensis* has never been illustrated, it has seemed advisable to publish, with this phytogeographical note, a drawing of this species (Plate XXXIII).

Brazil: Territorio do Rio Branco. Lower Rio Branco, Tapanaruca. "Tree in clump, 3 meters; rouge flowers. Lowland, border of high forest." February 23, 1948, *Ricardo de Lemos Fróes 23003*.

Herrania kofanorum *R. E. Schultes sp. nov.*

Arbuscula parva, tenuis gracilisque, usque ad quindecim pedes alta, ex radice plerumque unus truncus erectus, cylindricus, apice ramosus, cinereo-nigro cum cortice scrobiculato et scabrido, usque ad septem cm. in diametro crescens. Rami ferrugineo-tomentosi, denique subglabrati, subteretes sulcatique. Ramuli similes sed tomentosiores. Folia ad trunci apicem collecta, ampla, digitata, longissime petiolata, septem-foliolata, stipulata. Stipulae caducae, lineares, acutae, 2.5–3 cm. longae, circa 3 mm. latae, siccae, extus hispidulae vel strigillosae, intus usu subglabrae. Petioli robusti, teretes sed obscurissime sulcati, basi leviter dilatati, subferruginei, densissime

atque molliter tomentosi, usque ad 30 cm. longi, 6 mm. in diametro. Foliola sessilia, inaequalia, lanceolato-oblonga, apice in cuspidem vel mucronem acutum usque ad 2 cm. longum producta, basi sensim attenuato-decurrentia, margine conspicue atque regulariter undulato-sinuata; laminis firme coriaceis, plerumque 17–30 cm. longis, 6–11 cm. latis, supra atroviridibus, glabris vel maxime sparsissime atque minutissime strigilloso-pilosiusculis albis cum pilis caducis, in venis praecipuis minute fusco-hirsutis, subtus fulvo-viridibus, densissime atque molliter stellato-pilosis, in venis praecipuis ferrugineo-tomentosis; costa nervisque utrinque sed subtus magis prominenter elevatis. Inflorescentiae fasciculatae, usque ad vigintiflorae. Flores caulini, longe pedicellati, e trunco inferiore orti, in racemis contractis prorumpentes. Alabaster magnus, elongato-globosus, 1.8 cm. in diametro, stellato-pilosus, subfulvo-rubens. Pedicelli robusti, teretes, articulati, densissime et minute stellato-pilosiusculi, subcinereis cum pilis, plerumque 9–10 mm. longi, 1–1.5 mm. in diametro, basi bractea brevi, lineari, acuta, dense tomentosa, 2–4 mm. longa subtenti. Calyx subcymbiformis, fere usque ad basim divisus. Sepala tria, valdissime inaequalia, subchartacea, margine integra, intus minute papillosa, subglabra atque probabiliter cito glabra, extus sparsim pilis stellato-strigosis usque ad 1 mm. longis et etiam pilis stellato-pilosiusculis minutissimis armata, aestivatione valvata; duo interiora elliptica, apice acuta, 10 mm. longa et 6 mm. lata; exterius rotundato-ovatum, 15–16 mm. longum, 15 mm. latum, apice rotundatum et saepe profunde (usque ad 2 mm.) incisum, incisura ut sulcus medianus ad laminae basim intus extensa. Petala quattuor vel quinque, rotundato-obovata, sessilia, concava, apice valde cucullata, glabra, utrinque (sed extus magis) muricato-papillosa vel granulosa, atrorubentia, quinquenervia, purpureis cum venis longitudinaliter stri-

ato-venosa, superne in ligulam extensa, 9 mm. longa, 7 mm. lata. Petalorum ligulae filiformes, pendulae, membranaceae, omnino glabrae sed basi minute granulosae, plusminusve 1 mm. latae, 80–100 mm. longae, basi valde dilatatae. Tubus stamineus quinquedivisus, staminibus invicem duo- et quattuor-antheriferis, filamentis valde complanatis, brevibus liberisque. Staminodia conspicue petaloidea, lanceolato-elliptica, apice acuta, basi attenuata, utrinque grosse muricato-papillosa, margine integra 22 mm. longa, 6 mm. lata. Ovarium sessile, elongato-ovoideum, distincte decemcostatum atque quinqueloculare, ochraceum, densissime stellato-pilosum, 2.5 3 mm. in diametro. Pistillum complanatum, 3 mm. longum, glabrum, simplex. Fructus ignotus sed luteus in maturitate dicitur.

Herrania kofanorum differs from its very close ally *H. balaënsis* Preuss in being smaller, in having leaflets only half as large, and in having the sepals very conspicuously unequal instead of nearly alike. *Herrania kofanorum* has two inner sepals which are elliptic, 20×6 mm. and an outer one which is rotund-ovate, 15–16×15 mm., whereas *H. balaënsis* has three lanceolate-elliptic sepals which measure 14×6 mm. Furthermore, the outer sepal of *Herrania kofanorum* is so constructed that it is often conspicuously slit to a depth of 2 mm., and this slit is prolonged as a furrow to the base of the interior of the sepal (when the split is not present, there is a markedly thin furrow); nothing similar is seen in *H. balaënsis*. Both these species are related to *Herrania Dugandii*.

Ecuador: Río San Miguel o Sucumbíos, entre el Río Putumayo y la Quebrada Teteyé, alt. 260 m. Nombre Kofán: *ko-kee-oí-chu*. "Small tree, 15 ft. Flowers large, deep red-purple in all parts. Fascicles many-flowered. *Cacao silvestre*." March 29, 1942, *R. E. Schultes 3478*. (Type in Econ. Herb. Oakes Ames; Duplicate types in Herb. Nac. Colomb., Herb. Gray, U. S. Nat. Herb.).

Colombia: Comisaría del Putumayo, Río Putumayo, trocha entre

Puerto Ospina y Concepción, alt. 250 m. Nombre vulgar: *cacao silvestre, cacao de monte.* "Small tree, 12 ft. tall. Flowers dark red. Kofán name: *ko-kee-oí-chu.*" April 20–30, 1942, *R. E. Schultes 3670.*

Herrania Mariae (*Mart.*) *Decaisne ex Goudot* var. **putumayonis** *R. E. Schultes var. nov.*

Arbuscula usque ad duodecim vel quattuordecim pedes alta, ab *Herrania Mariae* principaliter foliolis multo majoribus (usque ad 52 cm. longis, 18 cm. latis), lanceolato-ellipticis (non conspicue rhomboideis); petiolis robustioribus et longioribus; floribus majoribus, alabastro globoso usque ad 17 mm. in diametro; ligulis brevioribus, usque ad 70 mm. longis sed saepissime paulo brevioribus differt.

Additional material may indicate that this concept is deserving of specific rank. At the present time, however, it would seem advisable to treat it as representing a variety of *Herrania Mariae*. The fruit of *Schultes 4010* is hardly distinguishable from that of *Herrania Mariae*. The flowers have several differentiating characters, the most conspicuous of which is the shorter ligule. Vegetatively, the collection is extremely similar to *Herrania nycterodendron* (with the type plant of which it was growing) and differs markedly from *H. Mariae* chiefly in the departure from the typical rhomboid form of the leaflets and in their unusually large size. The type plant of *Herrania Mariae* var. *putumayonis* consisted of four or five trunks in a clump, whereas *H. Mariae* usually, if not always, is a treelet with a single trunk.

Herrania Mariae var. *putumayonis* may represent a western variant of the species which is most abundant in the eastern half of the Amazon basin.

Peru: Departamento de Loreto, Río Putumayo, entre los Ríos Igaraparaná y Yaguas, Puerto San Salvador o Pesquería, cerca de las Islas Batalón I y Batalón II. Alt. 100–150 m.(?). "Bark basally black, smooth, above grey-brown. Wood soft. Height 12–14 feet. Petals

deep blood-red. Ligules pink, white for half the length. Witoto name: *mu-sĕ-na*. Spanish name: *cacao silvestre.*" June 20, 1942, *Richard Evans Schultes 4010* (TYPE in Herb. Gray).

Herrania nitida (*Poepp.*) *R. E. Schultes* var. **aspera** (*Karsten & Triana*) *R. E. Schultes comb. nov.*

Brotobroma aspera Karsten & Triana ex Triana Nuev. jén. e esp. plant. fl. Neo-Granad. (1854) 12.

Herrania aspera (Karsten & Triana) Karsten in Linnaea 28 (1857) 447.

Arbuscula parva ab *Herrania nitida* principaliter foliolis utrinque asperioribus et apicem versus margine definite sinuatis, florum partibus omnibus sanguineo-purpureis, fructibus probabiliter minoribus differt.

With the scarcity of collections, it is rather difficult to evaluate this concept. It is certainly not specifically distinct from the widespread and somewhat variable Amazonian *Herrania nitida*. At the present state of our knowledge, it is probably best treated as a variety. The very definitely and regularly sinuate margin of the upper part of the leaflets is apparently a constant character, although in several of the Peruvian collections which I have assigned to *Herrania nitida* there is a tendency for the margin to be obscurely undulate.

Karsten, in discussing *Herrania aspera* (in Linnaea loc. cit.) and in pointing out its difference from *H. pulcherrima* Goudot, stated that it occurs "in vallis Orenocensis marginibus ad pedem Andium bogotensium meridensiumque. . . . et littora fluminis Magdalenae." He cited no specimens. The presumed type of the concept —*Triana 5333*—was collected in the Llanos of Villavicencio. The only other collections which have as yet come to my attention are a topotype, one from the Apaporis basin and several from the *trapécio amazónico*. Therefore, I believe that Karsten's assertion that *Herrania nitida* var. *aspera* is found in the Magdalena basin

may be erroneous and may have been based on a sterile collection of *H. albiflora*, superficially often rather similar. When Triana and Planchon (Prodr. Fl. Novo-Granat. (1862) 209) erroneously reduced *Herrania aspera* to synonymy under *H. pulcherrima*, additional confusion concerning the distribution of the concept resulted.

Colombia: Intendencia del Meta, Llanos de San Martín, Villavicencio, altitude 400 m., January 1856, *J. Triana 5333* (Type).—Comisaría del Amazonas, Río Amazonas, La Victoria. "Small tree. Edge of forest." August–September, 1929, *Llewelyn Williams 2816*.—Intendencia del Meta, Llanos de San Martín, Villavicencio, altitude about 500 m. "Dense forest. Small tree, 3 m. high. Leaves borne at summit; stem about 2 cm. in diameter, bearing red flowers in lower part." March 17, 1939, *E. P. Killip 34247*.—Comisaría del Vaupés, Upper Apaporis basin, Río Macaya near confluence of Ajaju and Macaya, near Puerto Hevea. Altitude 350 meters. Sandy, well-drained soil. "Treelet 12 ft. tall, basal diameter 3 inches. Bark smooth, black, thin. Fruit on lower portion of trunk, ellipsoid, 10-ribbed, long-tipped, rich green, stinging hairs up to 1 mm. long along ribs and between them to a lesser extent. Persistent sepals brown, dried, densely hirsute. Fruit (without peduncle which is 25 mm. long and 5 mm. in diameter) 9–10 cm. × 5 cm. in diameter." June 1943, *Richard Evans Schultes 5529*.—Comisaría del Amazonas, Trapécio amazónico, Leticia. Alt. about 100 m. September–November 1944, *Richard Evans Schultes 6141; 6143; 6144; 6147; 6149; 6192 A*.—Comisaría del Amazonas, Trapécio amazónico, Río Loretoyacu. Alt. about 100 m. "Small treelet. Tikuna Indian name: *cha-te̊-rá*." October 20–30, 1945, *Richard Evans Schultes 6640*.

Herrania nitida (*Poepp.*) *R. E. Schultes* fma. **sphenophylla** *R. E. Schultes stat. nov.*

Herrania nitida (Poepp.) R. E. Schultes var. *sphenophylla* R. E. Schultes in Caldasia 2, no. 6 (1943) 20.

Continued field studies of the rather variable *Herrania nitida* complex indicate the advisability of treating this concept as a form and not as a variety.

Herrania pulcherrima *Goudot* var. **pacifica** *R. E. Schultes var. nov.*

Arbor parva usque ad viginti quinque pedes alta, ab

Herrania pulcherrima foliolis valde membranaceis, supra minute stellato-pilosis et non muricatis vel subtubereculatis, lateralibus saepissime valde obliquis; floribus vulgo multo minoribus cum partibus (petalis ligulisque) ochraceis vel albis; fructibus minoribus (11.5 cm. longis, 7 cm. in diametro) principaliter differt.

This concept would seem to represent a Pacific coastal variant of *Herrania pulcherrima*, a species which, in its typical form, is endemic to the cordilleras of Colombia.

COLOMBIA: Departamento del Valle, Pacific coast, Río Yurumangui, Caimanero. Forest. Alt. 10 m. "Arbolito 6 m. Tallo 6–7 cm. diámetro, gris negruzco oscuro, leso con verrugas. Inflorescencias caulinares paucifloras. Capullos florales pardo-ocráceos." February 5, 1944, *J. Cuatrecasas 16010*.—Intendencia del Chocó, Río San Juan, vicinity of Palestina. Alt. 0–30 m. "Arbolito 8 m. Tallo 15 cm. diámetro. Hoja membranosa, gruesa, rigida, verde amarillenta. Pecíolo verde, ocráceo. Fruto 11.5 cm. × 7 cm., prismático-pyramidal, apuntado con 5 costillas muy salientes y otras cortas; algunos nervios muy marcados; verde amarillento." May 28, 1946, *J. Cuatrecasas 21337*.—Departamento de Antioquia, north of Dabeiba, road to Turbo. "Closed rain forest. Tropical, shady, wet. Alt. 300 m. Height of plant 5–6 m. Flowers cauline. Rose-white interior; red appendages 10 cm. long; corolla deep red. Grows deep in rain forest. Leaf and petiole with hairy brown wool." February 25, 1942, *Univ. California 3rd Bot. Gard. Exped. Andes 1942, 30173* (Leg. *R. D. Metcalf & J. Cuatrecasas*).

ECUADOR: "Foot of Western Cordillera. Alt. 100 m. In the shade of the forest. Tree 5 m. high, 7 cm. diameter. Bark blackish with small warts. Leaves alternate, palmate, with 7 leaflets; leaflets 60 cm. long; leafstalks 60 cm. long with 2 quite narrow, $2\frac{1}{2}$ cm. long stipules. Leaves and stem, when young, brownish velvet-hairy. Flowers on the old stem, on short peduncles. Flower almost 3 cm. in diameter, dark red, with 8 cm. long reddish-white, thread-like appendages. Fruit not seen, said to be cacao-like, with edible, white, sweet husks of the seeds. Rare. Not used. Vulg. *cacao de monte*." No date, *A. Rimbach 48*.—Provincia Pichincha, Santo Domingo de los Colorados. Alt. 800 m. "Especie árbores con flores directamente pegadas al tronco. Flores rojas." August 10, 1945, *M. Acosta-Solis 10923*.

Herrania purpurea (*Pitt.*) *R. E. Schultes* in Caldasia 2, no. 9 (1944) 333.

Theobroma purpureum Pittier in Fedde Rep. Sp. Nov. 13 (1914) 319.

The binomial *Herrania purpurea* was published as a *nomen nudum* in the first edition of Thomas Belt's "The Naturalist in Nicaragua" (1874) 116. Belt wrote: "About here grows a cacao (*Herrania purpurea*) differing from the cultivated species (*Theobroma Cacao*)." I have been unable to discover a description of the plant or a publication of the binomial prior to 1874. In the preface of his book, Belt stated that "Prof. D. Oliver of Kew has kindly named for me some of the plants." In the collection of *Herrania* at Kew, I did not find any specimen from Nicaragua collected prior to 1874 and annotated with this binomial. Dr. N. Y. Sandwith of Kew has kindly searched through the archives and reports that he can find nothing which might suggest that Oliver had published the binomial.

Pittier's description of *Theobroma purpureum* was based upon a Panamanian plant collection, and he made no mention of a prior publication of this specific epithet. There is no doubt that the binomial which Belt published refers to the same concept which Pittier later and independently described and for which he used the identical specific epithet. In accordance with the International Rules of Botanical Nomenclature, therefore, we must consider Pittier's *Theobroma purpureum* as the first valid use of the specific epithet.

Ternstroemiaceae

Mahurea tomentosa *Ducke* in Arqu. Inst. Biol. Veg. Rio Janeiro 1 (1935) 208; in Trop. Woods 43 (1935) 22.

It would appear that this collection is the first of the genus *Mahurea* from Colombia. There are several species from Venezuela, the Guianas and Brazil, usually

associated with the old Duida-Roraima type of flora. *Schultes 3929* was collected in a sandy caatinga at La Chorrera, a locality having many elements in common with the floras of the Apaporis, Vaupés and upper Río Negro caatingas.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera and vicinity. "Bush. Flowers pink." June 6, 1942, *Richard Evans Schultes 3929*.

COMBRETACEAE

Combretum karijonorum *R. E. Schultes sp. nov.*

Frutex scandens. Ramuli glabri et subnitidi, teretes, 2 mm. in diametro. Petioli robustiores, brunnei, 4 mm. longi. Folia papyracea, atroviridia, ovata, plerumque 11–16 cm. longa, 8.5–11 cm. lata, basi rotundata, apice breviter acuminata, integra, supra nitida, omnino glabra; venis secundariis plusminusve septem supra haud impressis, subtus prominenter elevatis, tertiis prominentioribus. Inflorescentiae ex axibus superioribus prorumpentes, usque ad 15 cm. longae. Flores adhuc ignoti. Samara 30 mm. longa, 12–13 mm. lata, omnino glabra, maturitate rufescentia, alis elongato-linearibus, 2.5–3.5 mm. altis, margine subintegra, transverse minutissime striolatis.

Combretum karijonorum appears not to be closely allied to other known Amazonian species of the genus and can be distinguished at once by its unusual fruit. The samara is very long in relation to its lateral dimensions—the body being elongate-lanceolate and the wings linear, nearly as wide at the center as at the ends. This shape is unusual in *Combretum*, There are other differences of lesser importance, such as the extreme reduction of the petioles which gives the large and ovate leaves almost a subsessile appearance.

The specific epithet refers to the once populous and fiercely warlike tribe of Karijona Indians, who formerly

inhabited the upper Apaporis basin, now reduced to fewer than twenty individuals residing on the Río Vaupés and at La Pedrera on the Río Caquetá. The Karijonas refer to this plant as *le-chĕ-mah*.

COLOMBIA: Comisaría del Vaupés, Macaya-Ajaju River confluence. Mount Chiribiquete. "Vine. Fruit green, with reddish tinge." May 15–16, 1943, *Richard Evans Schultes 5452*.

Combretum rotundifolium *L. C. Richard* in Act. Soc. Hist. Nat. Paris 1 (1792) 108.

In spite of its abundance in Amazonian Colombia, *Combretum rotundifolium* does not seem to have been reported from this Republic. Collections have also been made in Venezuela and the Guianas.

COLOMBIA: Comisaría del Vaupés, Macaya River, vicinity of Cachivera del Diablo and mouth of river. Altitude about 300 meters. "Flowers red. Vine." May 1943, *Richard Evans Schultes 5501*.

APOCYNACEAE

Ambelania cuneata *Mueller-Argoviensis* in Martius Fl. Bras. 6, pt. 1 (1868) 17.

This represents apparently the second collection of *Ambelania cuneata*. The type was from the upper Río Negro near the confluence of the Ríos Guainía and Casiquiare.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Caño Pacú. Sandy or rocky savanna. "Bush. Flowers yellowish." March 6, 1944, *R. E. Schultes 5815*.

Ambelania zschokkeiformis *Markgraf* in Notizbl. Bot. Gart. Berlin 12 (1935) 295.

The two collections cited represent apparently the second and third collections of this species, which was described on the basis of material which Ducke found on the Mauésmirím, an affluent of the Rio Maués. The Marmellos material establishes the occurrence of *Ambelania zschokkeiformis* in the great Rio Madeira basin and greatly amplifies the known range of the species.

Brazil: Estado do Amazonas, Rio Marmellos (affluent of Rio Madeira), Igarapé de Poté. "Small treelet growing in dense stands on sand bars. Trunk very stout at base, up to 18 inches in diameter rapidly tapering upwards. Bark light grey-brown, corky. Flowers cream. Latex white. Trunk always grows at 20° angle from vertical against current. 'Seen only in Marmellos' according to inhabitants. One of most characteristic sand bar plants. In rainy season almost completely submerged. Common name: *boia*." August 6, 1945, *Richard Evans Schultes & Edgar Cordeiro 6514*.—Same locality, near mouth of river. "*Boia*. On sand bars." August 12, 1945, *Richard Evans Schultes & Edgar Cordeiro 6533*.

EXPLANATION OF THE ILLUSTRATION

Plate XXVII. Parascheelia anchistropetala *Dugand*. Habit photographs.

Photographs by R. E. Schultes

Plate XXVII

EXPLANATION OF THE ILLUSTRATION

PLATE XXVIII. (Upper figure). HERRANIA KOFANORUM *R. E. Schultes*. Habit photograph of flowers of *Schultes 3478*.

Photograph by R. E. SCHULTES

(Lower figure). HERRANIA PULCHERRIMA *Goudot* var. PACIFICA *R. E. Schultes*. Habit photograph of the fruit.

Photograph by J. CUATRECASAS

Plate XXVIII

EXPLANATION OF THE ILLUSTRATION

PLATE XXIX. HERRANIA CAMARGOANA *R. E. Schultes*. (Upper figure). Habit photograph of flowers of *Schultes & Pires 9130*.

(Lower figure). Habit photograph of fruits of type plant.

Photographs by R. E. SCHULTES

Plate XXIX

EXPLANATION OF THE ILLUSTRATION

PLATE XXX. (Upper figure). HERRANIA MARIAE (*Mart.*) *Decaisne ex Goudot* var. PUTUMAYONIS *R. E. Schultes*. Habit photograph of flowers and fruits of type plant.

(Lower figure). AMBELANIA ZSCHOKKEIFORMIS *Markgraf*. A colony along the bank of the Rio Marmellos, Brazil.

Photographs by R. E. Schultes

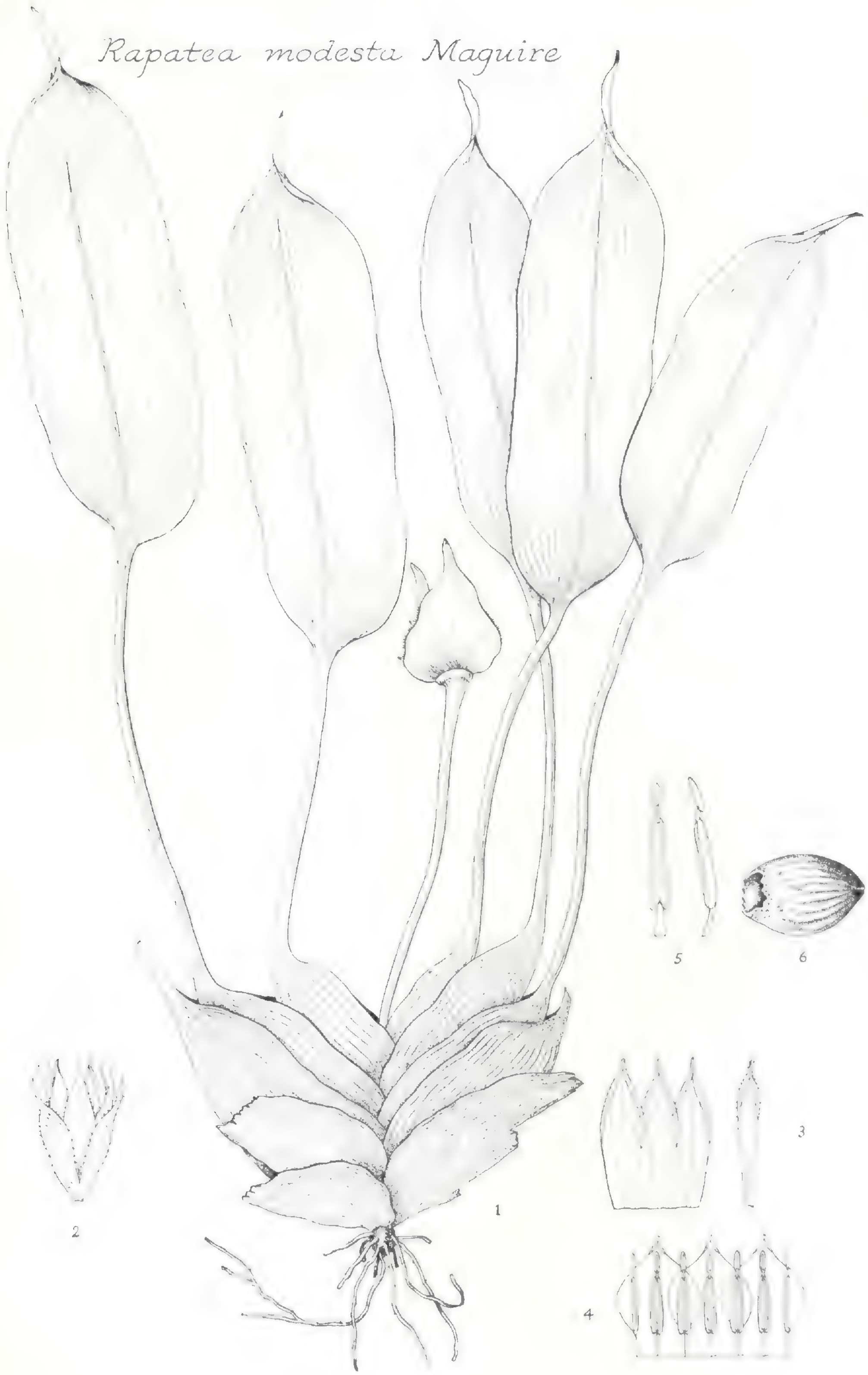
Plate XXX

EXPLANATION OF THE ILLUSTRATION

PLATE XXXI. RAPATEA MODESTA *Maguire*. 1, entire plant, about one third natural size. 2, spikelet, somewhat more than one half natural size. 3, bractlet of spikelet, somewhat more than one and one half times natural size. 4, calyx, semi-diagrammatic, shown spread out in a single plane, somewhat more than one and one half times natural size. 5, corolla, semi-diagrammatic, shown spread out in a single plane, stamens attached in position, somewhat more than one and one half times natural size. 6, stamen, front and side view, somewhat more than twice natural size. 7, seed, adaxial face, somewhat more than twice natural size.

Plate XXXI

Rapatea modesta Maguire



EXPLANATION OF THE ILLUSTRATION

PLATE XXXII. HERRANIA CAMARGOANA *R. E. Schultes*. 1, leaf, about one quarter natural size. 2, flower, about one half natural size. 3, petal, about twice natural size. 4, staminode and anthers, about twice natural size. 5, ovary and style, about four times natural size. 6, fruit, about one half natural size.

Drawn by E. W. SMITH

HERRANIA Camargoana
R.E. Schultes
1
2
3
4
5
6
F.E.C. Smith

EXPLANATION OF THE ILLUSTRATION

PLATE XXXIII. HERRANIA KANUKUENSIS *R. E. Schultes*. 1, leaf, about one sixth natural size. 2, fruit, about one half natural size. 3, portion of under surface of leaflet, showing pilosity, about four times natural size.

Drawn by E. W. SMITH

HERRANIA kanukuensis
R.E.Schultes
3
1
2
E.W.Smith

EXPLANATION OF THE ILLUSTRATION

PLATE XXXIV. HERRANIA KOFANORUM *R. E. Schultes*
1, leaf, one half natural size. 2, flower, one half natural size. 3, petal, about twice natural size. 4, staminode and anthers, about twice natural size. 5, ovary and style, about four times natural size.
Drawn by E. W. SMITH

PLATE XXXIV

EXPLANATION OF THE ILLUSTRATION

PLATE XXXV. HERRANIA NYCTERODENDRON *R. E. Schultes*. 1, leaf, about one quarter natural size. 2, flower, one half natural size. 3, staminode and anthers, about twice natural size. 4, ovary and style, about four times natural size. 5, fruit, about one half natural size. 6, portion of under surface of leaf, showing pilosity, about four times natural size.

Drawn by E. W. SMITH

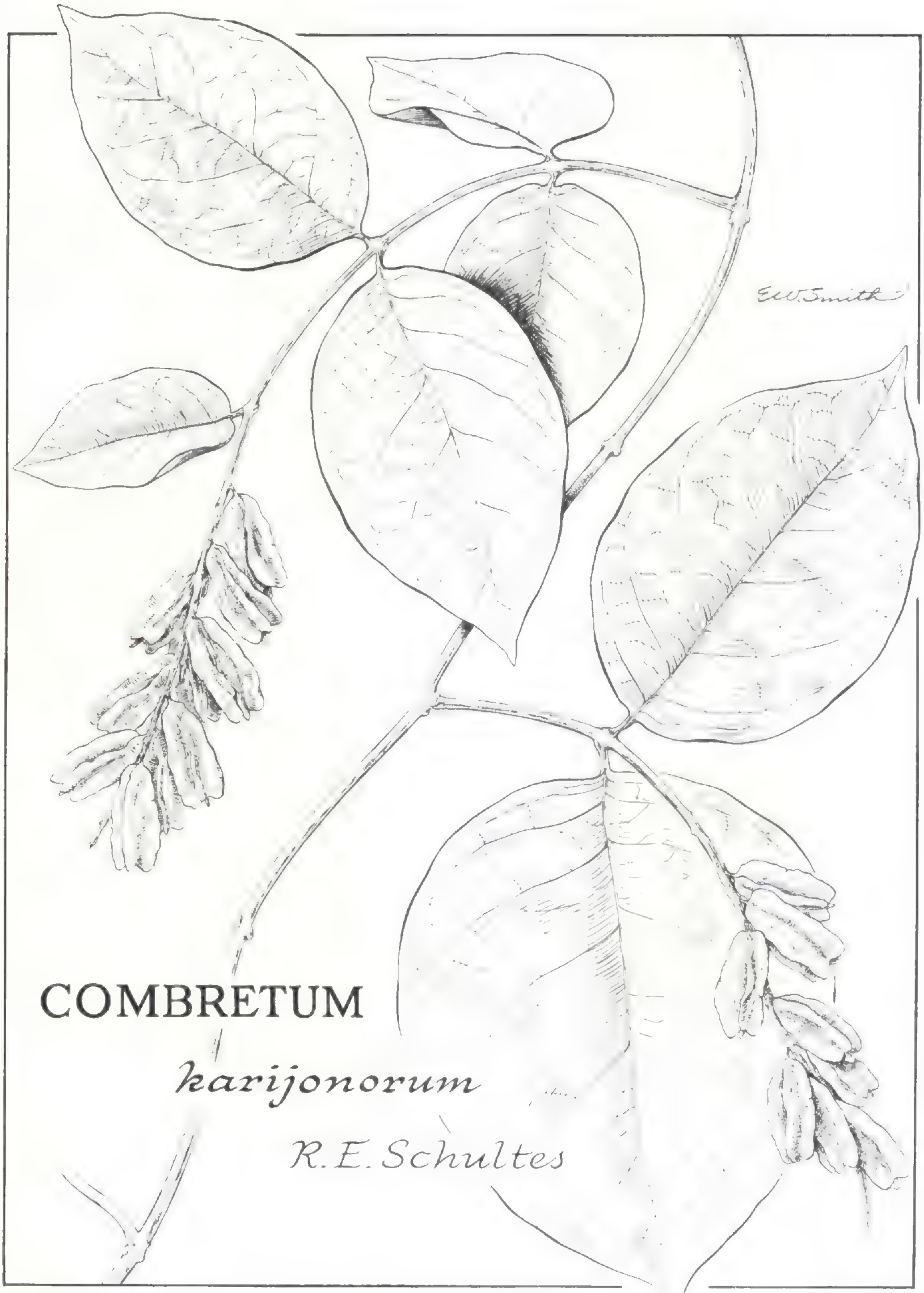
PLATE XXXV

EXPLANATION OF THE ILLUSTRATION

PLATE XXXVI. COMBRETUM KARIJONORUM *R. E. Schultes*. Habit drawing of fruiting branch from the type plant, natural size.

Drawn by E. W. SMITH

Plate XXXVI



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NOTES ON PERUVIAN CINCHONAS—I

BY

W. H. HODGE[1]

THE numerous collections of species of the genus *Cinchona* made throughout the Andes during the recent war by botanists of the Foreign Economic Administration (formerly the Office of Economic Warfare) have made it possible to reexamine critically the nomenclature and taxonomy of this admittedly difficult group. During the past century, dozens of species were described in the genus, but Standley (in Field Mus. Bot. 6 (1936) 24–33) claims that many of these "pertain to forms of scarcely or not at all more significance botanically than horticultural varieties of common garden vegetables." Therefore, in the most recent treatment of the genus for Peru, Standley (*ibid.*) reduced the number of Peruvian species to a mere handful, admitting, at the same time, that additional material might make it possible to amplify his treatment.

As cinchona botanist in Peru during the period 1943–1945, the writer had the unusual opportunity of collecting and seeing in their native haunts practically all the important forms of *Cinchona* occurring in that country. As a result of this fieldwork and subsequent herbarium

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study, it is his opinion that the number of species listed by Standley for Peru, and probably elsewhere, may be increased, for among the innumerable forms, varieties, and hybrids represented in the enormous literature of the genus, there are certain well-defined concepts which appear to be more or less stable and are easily recognizable especially in the field. Even among such a notoriously variable assemblage as is contained in the complex of *Cinchona pubescens* Vahl *sensu lat.*, there are entities which appear to be very stable. As an example, one might select the tree known as *C. succirubra* Pavon ex Klotzsch which was originally collected by Richard Spruce in Ecuador. This tree wherever grown, in the Far East, in Guatemala, and elsewhere, although often under ecological conditions quite different from its home-land, remains apparently true to type, not only in its general morphological characteristics, but also in such physiological features as the patterns of alkaloidal yield.

This is understandable, for the Andean terrain, like any lofty highly-dissected mountain mass, offers an extraordinary range of very localized and disjunct habitats which have permitted active speciation to occur. Certainly if adjacent Andean *hoyas*, isolated as they often are from their neighbors, can be marked by considerable local endemism among some groups of plants, why then cannot they be so considered as to their cinchonas as well?

The writer feels that certain entities at present considered as synonyms in the genus *Cinchona* were reduced to synonymy often without sufficient study and clearly must be resurrected if any semblance of order is to come out of this chaotic group. Rusby (in Bull. Torrey Bot. Club 58 (1931) 523–530) already has protested Standley's recent treatment of the genus for Bolivia (in Field Mus. Bot. 4 (1931) 266–273), and the present writer agrees

with him in part, at least regarding the status of certain species such as *Cinchona Calisaya* Weddell which he has met with in his travels in southern Peru. Indeed, the writer cannot but feel that a great deal of careful taxonomic work was accomplished by cinchona botanists of the past centuries and especially by such men as Ruiz & Pavon and Weddell who had become well acquainted with the species in the field.

In the pages that follow, the writer initiates a critical discussion of some poorly known Peruvian cinchonas in the light of his observations in the field. The species treated in this paper are easily recognizable because of the rather dense covering of hairs found on the leaves and young growth. Our knowledge of these species, up to now, has been based for the most part on the most meagre and fragmentary of herbarium material; in fact, certain of them are known only from types collected more than a century ago. Inasmuch as the existing descriptions of these plants are either incomplete or based only on the original collection, the writer includes modified descriptions based on a study of recent collections.

Besides his own collection (WHH), the first set of which is deposited in the herbarium of the United States National Arboretum (USNA), the writer has examined specimens of cinchonas in the following institutions, to whose curators he is indebted for kindnesses received during the study: Chicago Museum (F), Gray Herbarium (G), University of Massachusetts (M), New York Botanical Garden (NY), Museo Historia Natural "Javier Prado" of Lima (L), the United States National Herbarium (US), and the herbarium of the Estación Agrícola de Tingo María in Perú (TM).

Cinchona carabayensis *Weddell*

The identity of this cinchona has remained uncertain,

since it was incompletely described by Weddell (in Ann. Sci. Nat. III. 10 (1848) 9) from fruiting material collected by him in the Province of Carabaya (Dept. of Puno). While collecting in the same area during 1943, I discovered *Cinchona carabayensis*, but unfortunately my specimens of this species were among a number lost in transit in Peru. I still have very sketchy field notes and these may be of some value in relocating the species.

In the "Flora of Peru" Standley states that *C. carabayensis* was described "from thickets on the summits of the mountains between the valleys of the Province of Carabaya, especially near San Juan del Oro." Presumably these data came from the type label, for Weddell, in his original descriptions, merely gives the locality as "Peruvia." San Juan del Oro, now long abandoned and consequently not found on modern maps, was the most famous of the Spanish placer mining centers in this auriferous zone of southern Peru and was located on the ridges separating the watersheds of the Upper Inambari (here called the Huari-Huari) and Upper Tambopata Rivers. The much overgrown site of the mine may be reached by trail in about two days from the town of Sandia. Since Weddell's time the Province of Carabaya has been divided, with the result that old San Juan del Oro, as well as most other important cinchona areas (such as the Tambopata Valley, "Valle Grande" of the Huari-Huari, etc.) in the Department of Puno, are now included in the modern Province of Sandia. On the other hand, the modern Province of Carabaya, with Macusani as the capital, occupies only that part of the old Province of Carabaya lying west of a line drawn north and south through Limbani, a line which roughly parallels the Limbani-Mina Sto. Domingo-Astillero mule trail.

It was in this same general area in early 1943 that *C.*

carabayensis was rediscovered. About a half day northeast of Sandia the present trail into the eastern forested country (called *montaña* in Peru) forks into three trails, one of which continues down the valley of the Sandia River into the old San Juan del Oro area, another cuts off over a ridge to the east to enter the Tambopata Valley, and the third runs northwesterly over a very steep ridge into the Valle Grande section of the Huari-Huari Valley via the small Cachi-Cachi placer mine. The last-named trail passes in its preliminary ascent over a very steep ridge known as Ramospata which is covered with thickets and small trees characteristic of the Andean tree-line or *ceja de la montaña*, In this thicket community *C. carabayensis*, locally called *echenique*, is common and is particularly abundant between the *tambos* (trail shelters) known as Ichubamba and Ramospata.

Specimens of this cinchona are shrubs or occasionally small trees seldom attaining a height of over three meters. In its general habit the species resembles *C. Josephiana* Weddell (also called *echenique*) which is found at lower elevations on the same slopes of the Sandia Valley. From glabrous *C. Josephiana*, *C. carabayensis* may be separated easily by the presence of tomentum which covers all young growth, twigs, inflorescence branches, lower surfaces of the leaves, etc. From my field notes is appended here a general, if still inadequate, description of this tree transcribed in the field from fresh specimens in the hand:—"leaves averaging 15 cm. long by 5.5 cm. broad, similar in shape to those of *C. Calisaya* Weddell but dull in aspect rather than lustrous and smooth; petioles similar to those of calisaya; basal portion of the midrib with a suggestion of red on the upper surface; venation more complex than that of calisaya; young leaves with scattered pubescence on upper surfaces, all leaves with tomentum beneath, the same type

of tomentum covering all parts of young growth including inflorescences; flowers distinctly pink especially in bud, fainter when open, the calyx a deeper pink changing into deep red as the young green capsule develops."

In its densely tomentose habit *C. carabayensis* differs from all other cinchonas known to me from southern Peru. The closest relative of this rare tree of the Andes of Carabaya appears to be the similarly hairy *C. Pahudiana* Howard (discussed below), a better-known tree of the Chanchamayo Region of central Peru. These two species have been considered conspecific by Standley, but the writer's impression from field observation is that they are distinct. However, the fragmentary herbarium material of *C. carabayensis* and Weddell's rather incomplete description make it impossible to compare critically these two trees. Howard noted a similarity between the two species, but pointed out correctly that one was normally a shrub, the other always a tree; he also noted differences in the leaves. Until more abundant material of *C. carabayensis* is in hand, it seems best to consider it apart, especially since the two species are rather widely disjunct. It should be pointed out that *C. Pahudiana*, not *C. carabayensis*, was the species introduced into cultivation in Java and elsewhere in the past century.

In addition to the living plants, the writer has also examined material, possibly the type (ex herb. Paris), in the herbarium of the Chicago Museum (sheet no. 971330) and collected by Weddell in the "Province of Carabaya." Besides the differences noted above, the capsules of Weddell's specimen are much coarser and more woody than those of *C. Pahudiana*. Seed differences may also exist, for the ones examined are large in comparison with those of most Peruvian cinchonas. It is hoped that botanists who may get into this interesting area of southern Peru will keep their eyes open for this neglected species.

Cinchona glandulifera *Ruiz & Pavon*

As far as I can learn, this little-known species has not been collected until recently, since it was originally discovered and described by Ruiz and Pavon in central Peru. Standley discusses *Cinchona glandulifera* in his treatment of the genus in the Flora of Peru and states that, besides the herbarium specimen at Berlin (probably the type) which was destroyed during the war, material (an isotype?) is also to be found in the Delessert Herbarium. Fortunately a photograph (Field Museum neg. no. 102) was made of the Berlin specimen and this agrees very well with plates of this species published in the works of Ruiz and Pavon and of Howard.

Recently my good friend, Ing. Hernán Augusto (a Peruvian agronomist and Superintendent of Fundo Sinchono, and formerly associated with the U. S. Government Cinchona Mission in Peru), made available excellent specimens and data of an unidentified cinchona collected by him in the upper Monzón River valley near Tingo María in 1944. His material proved to represent *Cinchona glandulifera*, from the type locality, and was an excellent match for the specimen of Ruiz and Pavon. The type material of Ruiz and Pavon originated in the mountains near Chicoplaya ("in *Peruviae Andium montibus nemorosis ad Chicoplaya runcationes, Carpales dictas*"). The species is also reported by them from Monzón, Panatahuas, and Cochero (also written Cocheros or Cuchero).

The type locality of Chicoplaya is not shown on most modern maps[1]; it is a hacienda in the Monzón valley

[1] Chicoplaya, type locality of *Cinchona glandulifera*, and nearby San Antonio de Playa Grande, type locality of *C. micrantha* R. & P. apparently were not visited by Ruiz and Pavon but by their collectors, including Juan Tafalla, for the localities are not indicated on the map of the itinerary of Ruiz and companions recently published (Field

about midway between Monzón and Tíngo María. It is the lowland terminus of a mule trail running down the valley from the highland community of Tantamayo.

I have also collected this species in northern Peru near the hamlet of Pomacochas in the Department of Amazonas, and specimens referable to *C. glandulifera* were collected in the same department by Antonio Raimondi, and in the Department of San Martín by Richard Spruce. The specimens from Amazonas differ somewhat from typical and topotypical material in length of petiole and in leaf shape, but otherwise are quite like the tree as it occurs in central Peru. Inasmuch as *C. glandulifera* has been found as far north in Peru as northern Amazonas, it very likely occurs in the intervening territory, particularly on the western slopes of those Andean ranges lying west of the Huallaga River. This particular inaccessible sector is actually one of the least known botanically in Peru, at least as far as the genus *Cinchona* is concerned.

Unlike most other Peruvian species, *C. glandulifera* is a shrub, in its type locality averaging three meters high (Augusto!), and in the Pomocochas area seldom attaining a height of over two meters. It is a sun-loving species always occurring among other low-growing shrubs and grasses in open communities known among the Peruvians as *pajonales*. In Pomocochas this cinchona is dominant in the community in which it occurs. Such

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Mus. Bot. 21 (1940) 9). Ruiz and Pavon apparently got no farther than Cuchero at the confluence of the Chinchao and Huallaga rivers. The localities in question are both located in the Monzón River Valley which joins the Huallaga at the site of present day Tíngo María. Both Chicoplaya and San Antonio de Playa Grande may be found on the map ("Plan del curso de los rios Huallaga y Ucayali y de la Pampa del Sacramento") made by Manuel Sobreviela—one of several maps in the atlas accompanying Herndon and Gibbon's published account of the exploration of the valley of the Amazon (Executive, No. 53, 33d Congress, House of Representatives, Washington, 1854).

sites usually are to be found on open ridges generally close to timber-line where tree types are replaced by shrubby growth and herbaceous or suffruticose perennials. Where *pajonales* merge into woodlands, types of *C. pubescens* are found, and this species is of all the cinchonas the closest associate of *C. glandulifera*. In its choice of sites and in its shrubby growth-form, hairy *C. glandulifera* is identical with *C. Josephiana* Weddell of southern Peru. However, the latter plant is easily distinguished from the former by well-marked morphological differences, the most obvious being its glabrosity.

In central Peru this diminutive species with its narrowly elongate panicles is in flower from at least February to July. Diagnostic features of *C. glandulifera*, other than its shrub form and hairiness, are the very short capsules and very small seeds.

An analysis of a composite sample of bark from several individuals of this species from Pomocochas has yielded only traces of crystallizable alkaloids, principally cinchonine. Even if the shrub were of value as a source of alkaloids, the small size of the stems would prohibit profitable commercial exploitation.

There follows an expanded description of the species based on recent collections.

Cinchona glandulifera *Ruiz & Pavon* Fl. Peruv. et Chil. 3 (1802) 1, pl. 224.

A shrub or occasionally a small tree 2–5 m. high with several trunks, these as much as 7 cm. thick; bark ashy to dark gray, the outer surface marked with inconspicuous fine transverse fissures, the youngest branchlets pilose or hirsute; stipules 12–40 mm. long, elliptical to oblong, obtuse to acute, somewhat villose; leaves subsessile, or with short petioles 2–15 mm. long, the blades ovate to lanceolate or oblong-elliptic, 6–16 cm. long, 2.5–8.5 cm.

EXPLANATION OF THE ILLUSTRATION

PLATE XXXVII. Mule trail up the Ramospata ridge out of the Sandia Valley (Dept. of Puno) Peru. In the thickets in the foreground *Cinchona carabayensis* Weddell was rediscovered.

Photograph by W. H. HODGE

Plate XXXVII

EXPLANATION OF THE ILLUSTRATION

PLATE XXXVIII. CINCHONA GLANDULIFERA *Ruiz & Pavon* growing near Pomocochas (Dept. of Amazonas) Peru. Clump from which *Hodge 6113* was collected.

Photograph by W. H. HODGE

Plate XXXVIII

EXPLANATION OF THE ILLUSTRATION

PLATE XXXIX. CINCHONA PAHUDIANA *Howard*. A representative specimen (*Hodge 6243*) from the region of the Chanchamayo Valley in central Peru.

Photograph by W. H. HODGE

Plate XXXIX

EXPLANATION OF THE ILLUSTRATION

PLATE XL. CINCHONA PARABOLICA *Pavon* in thickets near Tabaconas (Dept. of Cajamarca) Peru.

Photograph by W. H. HODGE

Plate XL

broad, the tips acute to obtuse, bases acute to obtuse or occasionally subcordate, glabrous and sometimes somewhat lustrous above, hirsute beneath, especially on the nerves, midribs usually reddish when fresh, vein-pairs 7–12; panicles generally narrowly elongate but small and compact, leafy, hairy, terminal and axillary, many-flowered, the flowers short-pedicellate, often in nodding clusters; hypanthium about 1.5 mm. long, densely yellowish-pilosulose; calyx darker, 1.5–2 mm. long with short triangular teeth, pilosulose outside, glabrous within; corolla pink, 7–12 mm. long, tomentose outside; capsule short, 7–15 mm. long, elliptical to oblong, pubescent to glabrate; seeds small, about 4 mm. long.

COLLECTIONS EXAMINED:

PERU: Huánuco: Described from the mountains of Chicoplaya, Province of Huámalies, *Ruiz & Pavon;* photograph of authentic material (presumably the type) ex herb. Berlin (Field Museum negative no. 102). Alturas de Carash (Province of Huámalies), Monzón Valley, on trail between Monzón and Tantamayo, 1735 m., *Augusto* 8, 8A (TM, WHH).—Amazonas: Summit of trail running between Pomocochas and Yambrasbamba (Province of Bóngara), 7200 feet, *Hodge 6113* (L, M, USNA, WHH). Summit of ridge separating Pomocochas from Shipasbamba (Province of Bóngara), 8500 feet, *Hodge 6109* (L, M, USNA, WHH). Valle de Huayabamba (Province of Chachapoyas), 2500 m., *Raimondi 974* (L, WHH fragment).—San Martín: In monte Campana (Province of Lamas) prope Tarapoto (now San Martín) Peruviae orientalis, *R. Spruce 4832*, Aug. 1856 (G, NY), cited doubtfully as *C. officinalis* by Standley in the Flora of Peru.—Common names: *cascarilla negrilla*, *cascarilla delgada*, *cascarilla del pajonal* (Huánuco), *cascarilla negra* (Amazonas).

CINCHONA PAHUDIANA *Howard*

Although the status of *C. carabayensis* is uncertain because of the lack of ample herbarium material, the identity of *C. Pahudiana* is sure. This rather easily identified species was originally collected by Justus Charles Hasskarl near Uchubamba which is a hamlet in the valley of the Tulumayo River (near the Chanchamayo Val-

ley) in the Province of Jauja and Department of Junín. Through the efforts of Hasskarl, living plants of *C. Pahudiana* were established by the Dutch in their plantations in Java, but, owing to the poor quality of the bark, its cultivation was eventually abandoned. Howard has given a full description and much historical information about this species. The writer has collected ample material of this tree which locally abounds in the moist timberline forests of the upper Chanchamayo Valley along the auto road between Tarma and San Ramon and not far from the type locality. The description which follows is based on these recent collections:

Cinchona Pahudiana *Howard* Ill. Nuev. Quinol. Pavon (1862) pl. 21.

A small, often slender tree 5–7 meters high, 5–20 cm. in diameter; bark thin, gray to brown[1], the branchlets pilose, the hairs usually shed below the second girdle; stipules 14–35 mm. long, 7–17 mm. wide, oblong-elliptical, obtuse (rarely acutish), pilose on the outer surfaces; leaves petiolate; the petioles 3–10 mm. long, pilose or often densely tomentose; blades oblong-elliptical to ovate or obovate, 8–28 cm. long, 4–15 cm. wide, the tip rounded to obtuse, rarely acute, the base acute, decurrent onto the petiole, glabrate or sparingly hairy usually on the veins above, generally yellowish-pilose below with longer denser hairs on the veins, with 9–12 pairs of primary lateral veins; panicles many-flowered, terminal,

[1] Dried samples of bark have a strong lateral curvature and often show narrow longitudinal ridges; there is also a strong tendency for the outer cork layers to shed. Samples analyzed by the U.S. Government Cinchona Mission Laboratory in Lima (as were all others mentioned in this paper) indicate that the species is of little value commercially, a typical analysis of trunk bark of *Hodge 6243* yielding total alkaloids 4%, anhydrous quinine 0.53%, quinine sulfate 0.65%, cinchonidine 1.02%, quinidine traces, total crystallizable alkaloids 2.25%.

the branches generally tomentose, leafy-bracteate at the base, ultimate bracts linear, approximately 2 mm. or less long; hypanthium 2 mm. long, densely tomentose; calyx 2 mm. long, sparingly pubescent to glabrate particularly at anthesis, dentate nearly to the middle, the teeth erect, triangular-acute; corolla shell pink with a deeper redder shade on outer surfaces, tube 12 mm. long, limb 4 mm. long; capsule 10–30 mm. long, lanceolate, becoming much broader in extreme dehiscence, pubescent to glabrate, prominently 10-costate.

As stated above, *C. Pahudiana* is a small tree, never shrubby like *C. carabayensis*. In general habit it more closely resembles weedy forms of *C. pubescens* Vahl *sensu lat.*, and indeed it might perhaps better be included in a subspecific category of that species. As with a number of other cinchonas, the degree of pubescence among individual trees in a stand shows considerable variation and this variability is especially to be noted in the juvenile population. Nevertheless, *C. Pahudiana* in its typical form seems to be easily identified and readily separable from *C. pubescens* both in the field and in the herbarium, because of its rather small, thick, generally tomentose leaves with bases decurrent onto the short petioles.

COLLECTIONS EXAMINED:

This species is apparently of very limited local distribution in the Department of Junín of central Peru from which area all specimens have been collected. Photograph (Field Museum photograph no. 37218) of authentic (possibly type) Hasskarl material from Uchubamba in the Province of Jauja. Province of Tarma, highway between Tarma and La Merced, about 10–12 km. below Palca, 6000 ft., *Evinger 530* (L, USNA). Province of Tarma, low-statured mountain rainforests in valley of Río Palca at Utcuyacu midway on auto road between Palca and San Ramon, 2000 meters, *Hodge 6238, 6239, 6240, 6241, 6242, 6243, 6244, 6248* (L, M, USNA, WHH). Thickets and open woods, Huacapistana (Province of Tarma), 1800–2400 meters, *Killip & Smith 24214* (F, NY, US) . . . has unusually long capsules; cited by Standley in Flora of Peru as *Ladenbergia Riveroana* (Wedd.) Standl. Pro-

vince of Jauja, Monobamba, 2000 meters, *Raimondi 2959, 9326, 11180* (L, WHH (fragment))[1]—Common name: *cascarilla crespilla chica* (Hasskarl!, Raimondi!).

Cinchona parabolica *Pavon ex Howard*

In 1936, Standley described *Cinchona Delessertiana*, basing his species on an unnumbered collection of Andrew Matthews (in herb. Delessert) from Chachapoyas (Department of Amazonas) in northern Peru. Commenting on his new species Standley wrote: "It is hard to understand why this Matthews collection, made long ago, has not been named, but I can find no mention of it in literature. The species is a well marked one characterized by the very dense pubescence of short, spreading hairs that cover all parts of the plant." Although the Matthews collection had remained unnamed since collected, a binomial, *C. parabolica* Pavon, had been applied to the same tree in 1862 when Howard published the "Illustrations of the Nueva Quinologia of Pavon." So Standley's name must be reduced to synonymy.

Fortunately we have not only an ample description (Pavon ex Howard) and a good illustration of the species, but also what may be considered to be the type specimen of *C. parabolica*. The latter, located in the herbarium at Madrid, was photographed by the Field Museum (photograph no. 29638) and yields the following data from the label: "*Cinchona parabolica, Cascarilla con hojas rugosas*, N. 562. L. 723. Ex Loxa." Howard states that his plate was drawn from this identical Madrid specimen. A study of the "type specimen" at Madrid and of Howard's plate and the original description indicate

[1] These specimens of Raimondi, located in the Raimondi Herbarium of the Museo de Historia Natural "Javier Prado" in Lima were tentatively identified by me in Lima as *C. glandulifera* R. & P. (see Hodge, W. H.: "Notas sobre los especímenes de cinchona del Herbario de Raimondi" in Bol. Mus. Hist. Nat. (Lima) 9 (1945) 63–64).

without doubt that *C. Delessertiana* and *C. parabolica* are identical.

An earlier name, *C. Mutisii* var. β. published by Lambert (Ill. Cinch. (1821) 9) may be referable to *C. parabolica*, but this is impossible to confirm without an examination of the type. No mention is made by Lambert of the collector of his specimen, but, like *C. parabolica*, it was probably collected by Juan Tafalla. Lambert's description is too brief for critical comparison with *C. parabolica*, but he does include in his diagnosis certain of the important features of this species:
"*foliis. . . . subtus ramulisque valde pilosis, margine undulatis subrevolutis, panicula brachiata valde pilosa. . . .*"
and also under var. β. . . . *foliis ovalibus obtusis basi rotundatis subcordatisve.*"

In 1849, Weddell took up Lambert's species, *C. Mutisii*, listing var. β. as var. *crispa*, but in 1869, Weddell, combining this variety with *C. parabolica*, transferred both entities to synonymy under another binomial of Pavon's, *C. rugosa*, a species from Cuenca, also published by Howard. A summary of the tentative synonymy of this cinchona and an expanded description based on recent collections follow:

Cinchona parabolica *Pavon ex Howard* Ill. Nueva Quinol. Pavon (1862) pl. 16.

Cinchona rugosa Pavon ex Howard *op. cit.* pl. 17.
Cinchona Mutisii Lambert var. β. Ill. Cinch. (1821) 9.
Cinchona Mutisii Lambert var. *crispa* Weddell in Ann. Sci. Nat. III, 11 (1849) 270.
Cinchona rugosa Pavon ex Howard var. *crispa* Weddell in Ann. Sci. Nat. V, 11 (1869) 359.
Cinchona Delessertiana Standley in Field Mus. Bot. 6 (1936) 26.

A small tree, 6–8 m. high, up to 10 cm. in diameter;

the older fibrous bark light to dark gray or brown, marked with short rather indistinct transverse fissures; branchlets thick, four-angled, with very dense brown pilose hairs, internodes elongate; stipules erect, soon deciduous, oblong, 12–35 mm. long with an obtuse tip, densely hispidulose on the outer surface, glabrous on the inner surface; leaves medium-sized, petiolate, subcoriaceous, bullate or rugose, especially when fresh, margins conspicuously inrolled, particularly on the younger leaves; petiole thick, 1–2 cm. long, densely hispidulose-tomentose with brownish hairs; blades oval-elliptical to oblong, 6–19 cm. long, 3–9.5 cm. wide, with apex rounded or obtuse and subapiculate, base obtuse to truncate, above often at first densely appressed-pilose, later glabrate, with veins and veinlets deeply impressed, below everywhere densely hispidulose and with short loose brown to yellowish hairs; midrib thick, usually reddish above for about a third of its length, prominent below with approximately 12–16 pairs of conspicuous lateral veins; panicles small to medium-sized (8–30 cm. across), terminal, at least the younger branches densely hairy, leafy bracteate at the base, many-flowered, the sessile flowers densely aggregate, ultimate bracts linear, 3–4 mm. long; hypanthium 2–3 mm. long, densely fulvous-tomentose; calyx 3–4 mm. long, generally reddish, densely fulvous-tomentose, toothed to the middle, the triangular teeth erect, acute; corolla maroon (the color somewhat obscured on the tube and outer surface of lobes by the dense adpressed strigose hairs, but visible in the throat of the open flower), 12 mm. long, with lobes much shorter (2 mm.) than tube; capsule up to 25 mm. long, woody with a rough-pubescent outer surface, seeds 7–8 mm. long, narrowly elliptical.

I made several collections of *C. parabolica* in northern Peru during the period 1943–1945, and some of my field

observations may be pertinent. The species was first observed growing just east of Huancabamba at Tabaconas (in the Department of Cajamarca) which is some 200 kilometers (airline) northwest of the Province of Chachapoyas, the type region for *C. Delessertiana*. Subsequently trees were also observed near Bambamarca (Cajamarca). Although cinchonas were sought in the Chachapoyas region, the species was never seen there. Mathews' specimen undoubtedly originated not in Chachapoyas itself, whose environs have long been depleted of forest, but somewhere in the outlying fringes of that province. The range of the species extends into the Loja region of southern Ecuador, the data of Pavon published by Howard giving as localities "*in via collis Laterna, in collibus Vilcabamba, Valladolid, locis altis frigidis Sabaneta, Quebrada Onda et Cruz Grande nominatis, Provincia Loja.*" Thus *C. parabolica* is known from the Departments of Cajamarca and Amazonas (and undoubtedly eastern Piura) in northern Peru and extends northwards into the Provinces of Loja and Azuay in southern Ecuador.

C. parabolica is a rather small tree, the largest example seen by me reaching a height of about twenty-five feet and a diameter of eight inches. The species is perhaps the easiest of all cinchonas to recognize, because of the very dense pubescence (noted by Standley and others) which covers all parts of the young growth of the plant. But even more characteristic in fresh material (though often lost in pressed specimens) is the strongly bullate or rugose nature of the subcoriaceous leaves whose margins often inroll or curl under conspicuously. These characters possibly account for the Spanish name *crespilla* which is not only used today among *cascarilleros* of northern Peru, but also is cited by Pavon in his descriptions of *C. parabolica* and *C. rugosa* from Ecuador. The thin, light-to-dark gray bark of this tree is quite fibrous

and the outer bark tends to show a very slight cross-fissuring. This is usually a sign among cinchonas of a valuable bark, but in this case it is almost completely lacking in alkaloids (traces only), recent wartime analyses made by the laboratory of the U.S. Government Cinchona Mission in Lima checking with the results obtained by Howard in the last century.

In northern Peru, the moist highland forests where cinchonas abound (6000–8000 feet), the so-called "cove forests," are isolated from one another by *pajonales* (grasslands or cultivated areas) and are usually limited to local *quebradas*. The ridge-margins of such forests are made up of smaller second-growth species which merge gradually and deeper in the *quebrada* with the taller dominant species of the forest climax. *C. parabolica* is a tree of the second-growth areas bordering these forests, where it is often found intermixed with a weedy variety of *C. pubescens*, called "*amarilla*," and at higher elevations sometimes with the variety of *C. officinalis* known as *loja*. Within the climax forest, often only a quarter-mile distant, large trees of *colorada*, another variety of *C. pubescens*, may grow. Thus *C. parabolica* is in close association, in northern Peru at least, with three other cinchonas. Despite this, I have not observed any signs of hybridization between *C. parabolica* and associated species of the genus.

COLLECTIONS EXAMINED:

ECUADOR: Type of *C. parabolica* "ex Loxa" (localities cited by Howard include Laterna, Vilcabamba, Valladolid, Sabaneta, Quebrada Onda, and Cruz Grande); photograph of type ex herb. Madrid (Field Museum negative no. 29638). Type of *C. rugosa* from the Province of Cuenca (Pavon ex Howard). Type of *C. Mutisii* var. β. from the Province of Loja (Pavon ex Lambert).

PERU: Amazonas: type of *C. Delessertiana* from the Province of Chachapoyas, *Mathews* (herb. Delessert, Standley!). A specimen representing *C. Delessertiana*, in the herbarium of the New York Botan-

ical Garden, bearing the label "*Mathews*, Peruvia, 1862" probably represents an isotype of Standley's species. The date appears to be incorrect, for Mathews died in 1841.—Cajamarca: Province of Jaen, border of cove forest in "Quebrada Pajonal," Tabaconas, 7000–8000 feet, *Hodge 6040*, *6054* (L, M, USNA, WHH). Frontier trail between San Ignacio and Huancabamba, approximately 8000 feet, *Hodge 6052* (L, M, USNA, WHH).—Common names: *cascarilla crespilla*, (Cajamarca, Loja); *Cascarilla crespilla con hojas rugosas* (Loja).

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PREHISTORIC PLANT REMAINS FROM BAT CAVE

BY

C. E. SMITH, JR.

DURING the summer of 1948, an archeological expedition under the direction of Mr. Herbert W. Dick of the Peabody Museum of Harvard University discovered an abundance of plant remains in a series of dry caves in New Mexico. The maize remains in this material have already been reported on (Mangelsdorf and Smith 1949). The balance of the plant material will be discussed in the present paper.

DESCRIPTION OF THE SITE

The site is known as Bat Cave. It is situated on the edge of the Plains of San Augustin in Catron County in west central New Mexico. The topography of the region has largely been determined by ancient Lake San Augustin, which formed the caves. The lake basin is a level expanse of fine water-laid material with occasional spots of alkali in the playa. It is almost entirely surrounded by mountainous terrain and is approximately 60 miles long and 6 to 20 miles wide.

The Bat Cave site consists of a large rock shelter (75 feet by 100 feet) with a series of smaller caves at one side. The smaller caves are 10 to 30 feet deep, and about 10 to 15 feet from the present floor to the roof near their

mouths. All of the prehistoric material described below came from these small caves.

Present Vegetation

A description of the present vegetation of the area will serve as a basis for comparison with the material to be described from the deposit. Near Bat Cave, the plains consist of a large playa supporting a sparse growth of four-winged salt bush (*Atriplex canescens* (Pursh) Nutt.), with areas of *Heliotropium curassavicum* L. and *Sporobolus airoides* (Torr.) Torr. The transition zone from the plain to the fossil lake terraces is marked by Russian thistle (*Salsola pestifer* A. Nels.). On the terraces *Bouteloua hirsuta* Lag. forms a thicker ground cover than is present on the plains. Numerous plants of the groundsel (*Senecio longilobus* Benth.), stickseed (*Lappula Redowskii* (Hornem.) Greene), stickleaf (*Mentzelia pumila* (Nutt.) Torr. & Gray), paintbrush (*Castilleja minor* A. Gray), mock pennyroyal (*Hedeoma Drummondii* Benth.) and verbena (*Verbena ciliata* Benth.) show that this area is relatively free of alkali. In the rocky areas of the terraces a shrubby vegetation is present. *Fallugia paradoxa* (D. Don) Endl. (Apache plume) is very common, while *Rhus trilobata* Nutt. ex Torr. & Gray, *Forstiera*, *Lycium* and *Ribes* spp. comprise the rest of the shrub flora near Bat Cave.

The arroyos and canyons nearby are better watered (although none have permanent streams) and consequently the herbaceous vegetation is more varied. Numerous members of the *Compositae*, *Boraginaceae*, *Labiatae*, *Leguminosae* and other families were collected. In no case, however, was there any extensive ground cover formed by these plants.

At an elevation of 200 to 400 feet above the level of the plains a distinct change in the vegetation is seen.

Pinus edulis Engelm. and *Juniperus* spp. are dominant, while *Bouteloua hirsuta* Lag., *Bouteloua curtipendula* (Michx.) Torr. and other grasses form an almost continuous ground cover with scattered herbaceous plants and cacti (mainly *Opuntia* spp.). In one canyon near Bat Cave there are several trees of *Pinus ponderosa* Dougl. ex P. Laws. No other occurrence of ponderosa pine was seen near the site.

During the dry season the vegetation has a distinctly xerophytic aspect emphasized by the scattered plants of *Opuntia* and *Mammillaria*. Only the heliotrope on the plains and the shrubs on the terraces remain green. The dark green of the piñon and juniper contrasts with the brown ground cover.

With the advent of the summer rains in July and August, many short-lived herbs appear over the plain and hills making the entire area green. Most of the vegetation blooms during this period. Heavy rains in the hills and mountains usually fill the canyon beds with temporary streams for several hours each day, and standing pools form on the playa.

Excavation

The vegetal material recovered from Bat Cave was collected during the course of excavation for archeological remains. Measured areas were carefully dug by hand troweling in twelve inch levels from the top of the deposit. The material of botanical interest was removed and packaged. These arbitrary strata have no relation to any archeological strata which may exist in the Bat Cave deposit. Many cubic yards of material were removed so that a fair sampling of the entire deposit was obtained. Vegetal artifacts, to be described later by Mr. Dick, were packaged separately. Aside from the maize remains previously studied, no attempt was made in the

field to separate cultivated plants from wild species, although the specimens of beans and squash recovered were obviously cultivated.

Determination of the Remains

All of the determinations are based upon characters of taxonomic significance. Fragmentary material has often been given only a generic name due to lack of the detail needed for specific determination. A small amount of the material proved indeterminable.

The identification of the wood and charcoal remains presented certain technical difficulties in handling the material. An unsuccessful attempt was made to soften the charcoal enough to permit sectioning. In most cases there was complete disintegration in the bleach solution. Some few samples did not crumble, but these did not soften sufficiently to be sectioned.

The wood remnants were softened by boiling. Because of partial disintegration and chemical change, it was found that no further softening by hydrofluoric acid treatment was necessary. Although some material was left unstained, the bulk of the wood sections were stained by Heidenhain's haematoxylin and safranin before being permanently mounted.

Except for the wood of the conifers and *Quercus*, the only tree genera represented, the material could only be identified after comparison with a set of slides made of known woods occurring at similar elevations today. Much of the old material represents such families as the *Chenopodiaceae*, *Rosaceae*, *Rutaceae*, *Rhamnaceae*, and *Compositae*.

The author wishes to express his sincere thanks for the aid and advice accorded him by Professor Paul C. Mangelsdorf, Professor Ivan M. Johnston, Professor Elso S. Barghoorn and the many others who have as-

sisted in the identification of the material. Especial thanks are due to Dr. S. F. Blake who identified the *Compositae*. Without this expert help, much of the vegetal material would have proven indeterminable.

Cultivated Plants

There is no evidence that the Bat Cave people cultivated any of the native vegetation, although species such as *Yucca* may well have been planted near the cave to ensure a regular supply of fiber and amole. Many of the herbaceous plants could have been grown with some success, but the bulk of the material was probably prevalent enough in the neighboring area to be easily collected as the need for it arose.

Cucurbita Pepo *Linnaeus* Sp. Pl. (1753) 1010.

Aside from the maize, the only obviously cultivated plants (that is, plants which are foreign to the region, and which show increased size and other marks of cultivation) are squash and beans. All of the cultivated squash remains are referable to *Cucurbita Pepo* L. The material was found in every level (I to VI) and comprises seeds, rind and stems.

The seeds of *Cucurbita Pepo* are all characterized by the moulding near the edge of the seed. Identification is possible because of the difference in texture between the center and the margin of all of the specimens. In specimens without discoloration, there is no difference in color in these areas. The seeds apparently all represent the same variety of *C. Pepo*, as there is no distinct difference apparent in any of them. Furthermore, there is no apparent size variation, as was shown by the maize, from the bottom to the top of the deposit.

Squash seeds

Level	Number seeds	Aver. width	Aver. length
I	2	9.5 mm.	16.0 mm.
II	3	9.9 mm.	15.6 mm.
III	4	9.0 mm.	15.0 mm.
IV	11	9.0 mm.	15.8 mm.
V	3	8.9 mm.	14.9 mm.
VI	9	9.1 mm.	16.4 mm.
Total Aver.	32	9.2 mm.	15.6 mm.

The average seed length is 15.6 mm., the largest strata average being 16.4 mm. for stratum VI. The average seed width is 9.2 mm., the largest strata average being 9.9 for stratum II.

Many pieces of rind were recovered from the excavation, none of which were sufficiently large to permit an accurate reconstruction of the size of the fruit. These remains show no significant differences in thickness or appearance. The surface texture is generally smooth, a few pieces showing slightly raised areas. There is prominent veining on the inside of all of the specimens. The thickness varies from about 1.5 mm. to about 3.5 mm., the average thickness being about 2.5 mm. Several pieces of rind showing the flower attachment were found. These were always concave in form, indicating that the fruit was probably the shape of our modern pumpkin.

Three stems were found in the course of the excavation. These are typical *Cucurbita Pepo* stems, flaring at the point of attachment with the fruit, pentagonal in shape and regularly fluted. Some idea of the size of the fruits may be gained from the size of the stems.

Squash stems

Level	Number stems	Length	Diameter (upper end)	Diameter (lower end)
II	1	4.3 cm.	1.8 cm.	3.0 cm.
IV	1	7.5 cm.	2.0 cm.	3.3 cm.
V	1	6.0 cm.	1.8 cm.	2.8 cm.

The oldest stem was found in stratum II and was apparently cut from the fruit while still green. The length of this specimen is 4.3 cm., with a diameter at the upper end of about 1.8 cm., and a diameter at the lower end about 3 cm. A whole stem, recovered from stratum IV, is 7.5 cm. long, 2 cm. in diameter at the upper end and 3.3 cm. in diameter at the lower end. The third specimen from stratum V is about 6 cm. long with a diameter of approximately 1.8 cm. at the upper end, and 2.8 cm. at the lower end.

Phaseolus vulgaris *Linnaeus* Sp. Pl. (1753) 723.

Only a few specimens of the common red bean were recovered. These have a smooth red coat with a white hilum or eye. There is no marked difference in size or appearance from level to level.

	Common beans		
Level	Number beans	Average width	Average length
III	2	8.5 mm.	13.0 mm.
IV	4	7.1 mm.	11.1 mm.
VI	1	8.0 mm.	11.0 mm.

The largest beans and the earliest in age were the two specimens from stratum III (average width 8.5 mm. and average length 13 mm.). In stratum IV the beans averaged 7.1 mm. in width and 11.1 mm. in length. From stratum VI a single bean 8 mm. wide and 11 mm. long was recovered. A buckskin bag of beans was found in stratum V, but these beans were not available for study. The apparent decrease in size upward in the deposit is probably due largely to the lack of sufficient material for comparison. There is no ready explanation for the lack of beans in strata I and II where both maize and squash are well represented.

Contrary to the evolutionary series presented by the Bat Cave maize, neither the cucurbits nor the beans show

any marked developmental trend. The material available for study does not furnish the detail found in the maize remains, and there is little variation discernible in the squash seeds and beans. The number of squash stems is also insufficient to furnish much information. Furthermore, the squash rind is devoid of any characteristic detail. From the material studied it may be concluded that at the time maize was first cultivated in a primitive form at Bat Cave, *C. Pepo* was cultivated for its rather large fruit. This squash apparently changed little if at all, while the maize underwent a distinct development. *Phaseolus vulgaris* does not appear in the oldest third of the Bat Cave deposit. There is no apparent change in character in the beans. It may perhaps be significant that the first beans appear in stratum III in which the first teosinte introgression is discernible in the maize.

Helianthus annuus *Linnaeus* Sp. Pl. (1753) 904.

Throughout the entire deposit flowering heads of *Helianthus annuus* L. occur. There is no indication that sunflowers were actually cultivated for their seed, although they may well have been, as in other parts of the southwest. The heads are of a size similar to those of the wild plants which are very common in better watered parts of the region today. These heads are about 2.5 to 3.5 cm. in diameter, and they vary in no way from the bottom to the top of the deposit.

Uncultivated Plants

The remainder of the Bat Cave vegetal remains may be assumed to be uncultivated, as they are mainly materials which could easily have been gathered in a wild state in the vicinity of the Cave. Descriptions are listed in taxonomic sequence according to the Engler and Prantl system, rather than according to abundance or

supposed importance in the deposit. It is felt that this will be a more usable plan for reference.

Pinaceae

Pinus edulis *Engelmann* in Wislizenus Mem. North. Mex. (1848) 88.

Piñon nuts were one of the most abundant plant remains found in the Bat Cave deposit. Many hundreds of broken shells were unearthed with a few whole nuts, several cones and an occasional twig.

In strata I and II this species is represented by nuts and cone scales. The remains in stratum III include a twig with needles attached, as well as cones, cone scales and seeds. From stratum IV piñon is represented by both seeds and cone scales. In both strata V and VI abundant seeds, cones, cone scales and twigs were recovered.

Thus, *P. edulis* is represented during the entire period of occupation of Bat Cave.

Pinus ponderosa *Douglas ex P. Lawson*, Agr. Man. (1836) 354.

Remains of this tree were found only in strata V and VI. In stratum V ponderosa pine is represented by the ends of two twigs with the needles adherent. A number of separate needles and a cone were recovered from stratum VI.

Pinus sp.

Wood of a species of *Pinus* was found in all strata except I.

Juniperus pachyphloea *Torrey* in U.S. Rept. Expl. Miss. Pacif. 4 (1857) 142.

Remains of juniper first occur in stratum II where the

plant is represented by large seeds. These may not be seeds of *J. pachyphloea*, although the resemblance is close. There were no remains identifiable as juniper in stratum III. The seeds and berry found in stratum IV are characteristic of *J. pachyphloea*, as are the numerous seeds, berries and twigs bearing leaves found in both strata V and VI.

Juniperus sp.

This genus is represented by wood fragments from all but the first two strata.

The large amount of juniper remains in the upper three strata contrasts sharply with the few seeds from stratum II and the lack of material from strata I and III. Using piñon remains as a criterion, there must have been juniper trees in the area for the entire time of occupation, so their absence in the lower parts of the deposit should be attributed to disuse rather than to lack of available material.

Typhaceae

Typha latifolia *Linnaeus* Sp. Pl. (1753) 971.

Remains of aquatic or marsh plants are relatively rare in the Bat Cave deposit. A portion of cattail leaf was found in stratum IV. The largest amount of cattail material, however, came from stratum V where numerous pistillate heads and a small staminate head of *T. latifolia* were recovered.

At the present time, cattails grow only in recently made ponds at Jacks Spring and T.U.T. Spring twelve miles across the plain from Bat Cave. The abundance of the cattail remains therefore suggests that during the period represented by strata IV and V there was a permanent body of shallow water nearby. Probably the large playa in front of the cave was at that time supplied

with sufficient summer rain and winter snowfall to support a shallow water vegetation.

Gramineae

Festuca Kingii (*S. Wats.*) *Cassidy* in Colo. Agr. Expt. Sta. Bull. 12 (1890) 36.

Fruiting heads of this grass were found in stratum VI.

Poa Fendleriana (*Steud.*) *Vasey* in U.S. Dept. Agr., Div. Bot. Bull. 13, pt. 2 (1893) pl. 74.

This grass was found in levels IV, V and VI of the Bat Cave deposit.

Poa secunda *Presl* Rel. Haenk. 1 (1830) 271.

A sample of *P. secunda* was among the grasses recovered from strata III and IV.

Elymus salina *M. E. Jones* in Proc. Calif. Acad. Sci. ser. 2, 5 (1895) 725.

Fruiting material was found in stratum VI.

Sitanion Hystrix (*Nutt.*) *J. G. Smith* in U.S. Dept. Agr., Div. Agrost. Bull. 18 (1899) 15.

This grass was also found represented only in stratum VI.

Trisetum Wolfii *Vasey* in U.S. Dept. Agr. Monthly Rept. Feb., March (1874) 156.

Several specimens of *T. Wolfii* were found in strata IV, V and VI.

Calamagrostis inexpansa *A. Gray* Gram. and Cyp. 1 (1834) no. 20.

C. inexpansa was found only in strata V and VI.

EXPLANATION OF THE ILLUSTRATION

PLATE XLI. (Upper fig.). Plains of San Augustin, New Mexico. Numerous clumps of saltbush (*Atriplex canescens*) thinly interspersed with grasses and a few herbaceous plants. In the middle foreground is the large playa in front of Bat Cave. Elevation about 6500 feet.

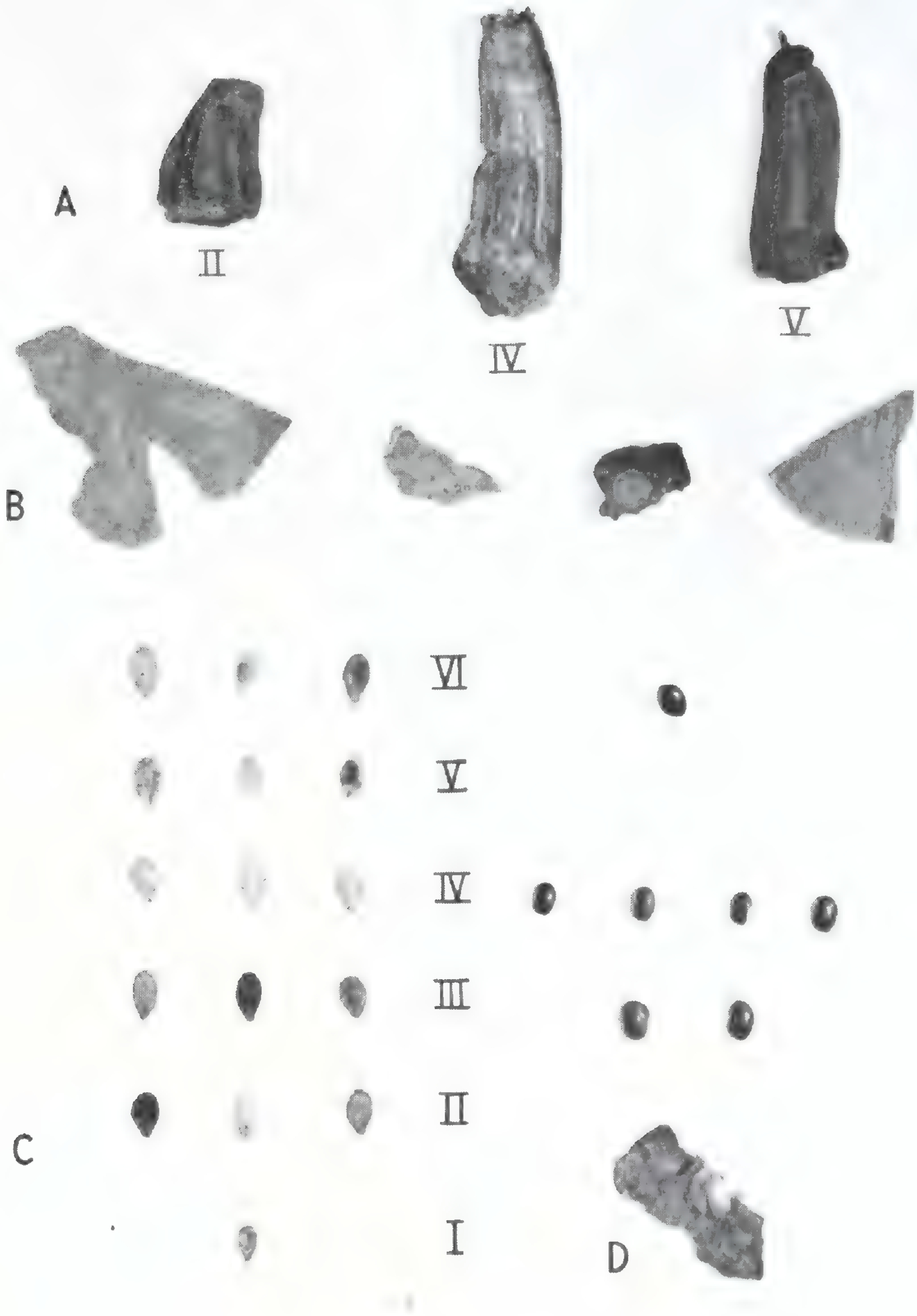
(Lower fig.). Juniper (left) and piñon on the hills directly above Bat Cave at an elevation of about 7000 feet. Ground cover here is heavier with grasses, herbaceous plants, and cacti.

Plate XLI

EXPLANATION OF THE ILLUSTRATION

PLATE XLII. Remains of cultivated squash (*Cucurbita Pepo*) and beans (*Phaseolus vulgaris*) from the deposit. A, stems from strata II, IV and V. B, specimens of rind from various strata. Note the concave basal portions. C, squash seeds and beans from strata as marked. D, fragment of rind of the native wild cucurbit (*Cucurbita foetidissima*) with attached seeds.

Plate XLII



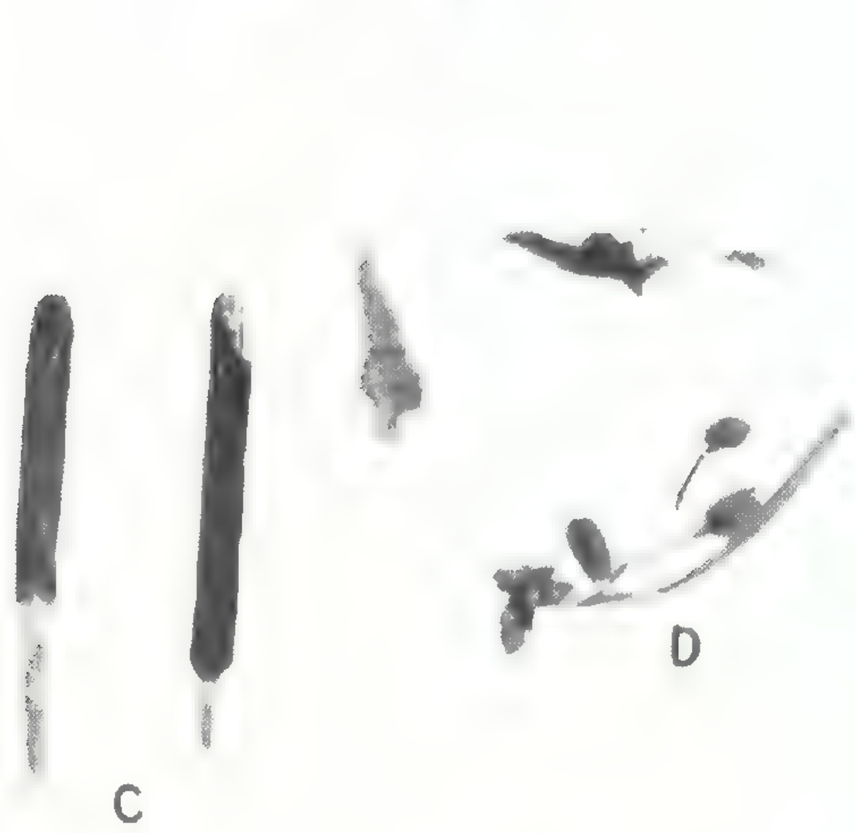
EXPLANATION OF THE ILLUSTRATION

PLATE XLIII. Gymnospermae and Monocotyledoneae from the Bat Cave deposit. A, *Pinus*. B, *Juniperus*. C, *Typha latifolia*. D, *Scirpus*. E, *Gramineae*. F, *Yucca*.

Plate XLIII

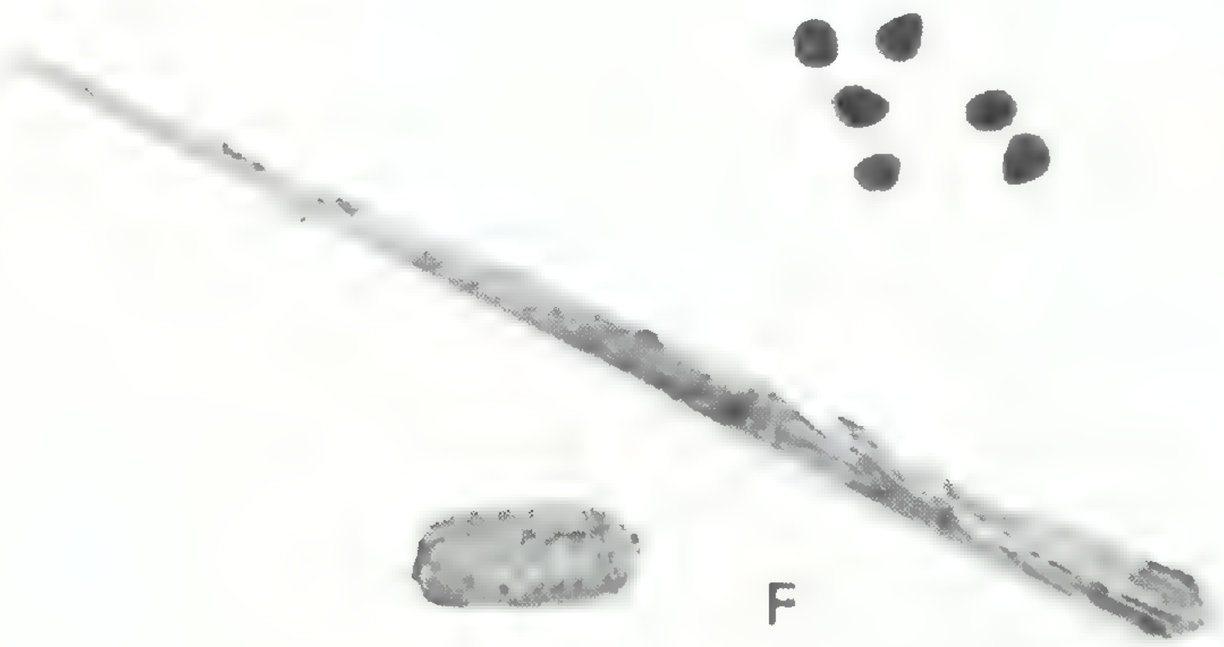
A

B


C

D

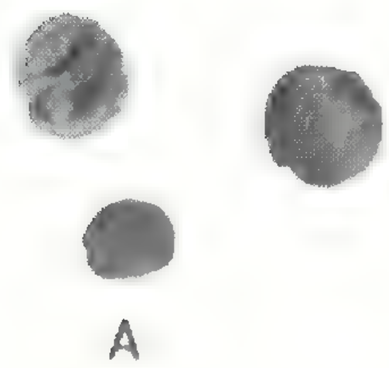
E


F

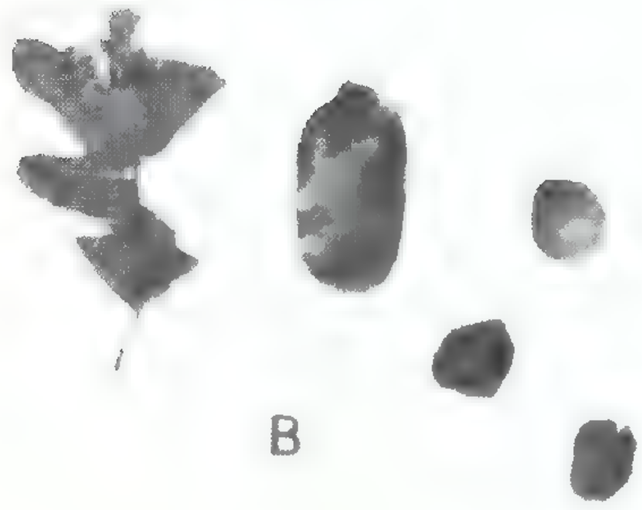
EXPLANATION OF THE ILLUSTRATION

PLATE XLIV. Dicotyledoneae from the Bat Cave deposit. A, *Juglans major*. B, *Quercus*. C, *Amaranthus*. D, *Suaeda*. E, *Opuntia*. F, *Helianthus annuus*.

Plate XLIV



A



B

C

D

E

F

Muhlenbergia rigens (*Benth.*) *Hitchcock* in Journ. Wash. Acad. Sci. 23 (1933) 453.

In strata IV and VI specimens of this grass were found.

Sporobolus airoides (*Torr.*) *Torrey* in U.S. Rept. Expl. Miss. Pacif. 7 (1856) 21.

Abundant remains of this grass were found throughout the deposit from stratum II upward.

Sporobolus Wrightii *Munro ex Scribner* in Bull. Torrey Bot. Club 9 (1882) 103.

Specimens of stems were found from stratum III upward. Fruiting heads of *S. Wrightii* were found only in stratum VI.

Bouteloua gracilis (*HBK.*) *Lagasca ex Steudel* in Nom. Bot. ed. 2, 1 (1840) 219.

The remains identified as *B. gracilis* were found in strata II and III.

Bouteloua hirsuta *Lagasca* Var. Ciene. 2, pt. 4 (1805) 141.

This is one of the most common grass remains from Bat Cave occurring from stratum II upward.

Sorghastrum nutans (*L.*) *Nash* in Small, Fl. Southeast. U.S. (1903) 66.

One specimen of this grass was recovered from stratum V.

Although much material representing the *Gramineae* was found, there is little which may be inferred from the material at hand. The prevalence of *Sporobolus airoides* and *Bouteloua hirsuta* throughout the deposit from stratum II upwards emphasizes the continuity in vegetation

in the area for the last several thousand years. No typically aquatic grasses were found. None of the grasses represented seem to have been gathered for food, so that a continuous maize economy probably furnished the entire grain supply for the Bat Cave people.

Cyperaceae

Scirpus Olneyi *A. Gray* in Boston Journ. Nat. Hist. 5 (1845) 238.

A complete inflorescence as well as several detached heads of *S. Olneyi* were found in stratum V.

Scirpus validus *Vahl* Enum. Pl. 2 (1806) 268.

A fruiting head of this bulrush was also found in stratum V.

Scirpus sp.

Fragments of the thick leaves of an aquatic plant apparently a *Scirpus*, were recovered from stratum IV of Bat Cave.

The presence of these typically aquatic plants, as well as *Typha latifolia*, in strata IV and V would seem to be conclusive evidence for the presence of a permanent, although perhaps shallow, body of water in the area of Bat Cave during the period of occupation.

Liliaceae

Yucca baccata *Torrey* in Emory Rept. U.S. & Mex. Bound. Surv. (Bot.) (1859) 221.

Identifiable remains of this species were found in strata II and III.

Yucca spp.

Numerous portions of yucca leaves, seed pods and seeds were found throughout the deposit. In addition,

two sections of rhizome, one from stratum IV and the other from stratum VI, were recovered. Minor differences show that at least two species are present, but lack of definitive characters makes impossible the accurate identification of these remains.

Salicaceae

Populus tremuloides *Michaux* Fl. Bor. Amer. 2 (1803) 243.

Poplar leaves were recovered from stratum V. The occurrence of this species with *Typha* and *Scirpus* further emphasizes the probable occurrence of higher precipitation in the area of Bat Cave in former times.

Juglandaceae

Juglans major (*Torr.*) *Heller* in Muhlenbergia 1 (1900) 50.

Numerous fragments of walnut shells occur throughout the Bat Cave deposits.

Fagaceae

Quercus Gambellii *Nuttall* in Journ. Acad. Nat. Sci. Phila. ser. 2, 1 (1848) 179.

Leaf remains of *Q. Gambellii* were found in strata V and VI.

Quercus grisea *Liebmann* in Overs. Danske Vidensk. Selsk. Forh. 1854 (1854) 171.

This species is represented in the deposit by leaves from stratum II upward.

Quercus sp.

Acorns were found in abundance in stratum III. A single acorn shell was recovered from stratum V.

Wood of *Quercus sp.* was found to be most prevalent in stratum III where six specimens were recovered. This genus is represented by only one other wood specimen from stratum VI.

It is not surprising to find *Quercus* remains in the Bat Cave deposit, as oaks grow in the area today in the better watered canyons. This further points to the great similarity of the past vegetation of the area to that of the present. It is unusual, though, that there should be so many acorn shells and no juniper remains in stratum III. At the time represented by this stratum there must have been a much greater abundance of oak in the area, which in turn would suggest a slightly higher rainfall than that of today.

Chenopodiaceae

Chenopodium sp.

Remains belonging to this genus were found in stratum IV.

Atriplex canescens (*Pursh*) *Nuttall* Gen. No. Amer. Pl. 1 (1818) 197.

Typical four-winged fruits of this plant were recovered from strata IV and VI.

The shrubby members of the *Chenopodiaceae* are represented by the wood of *Atriplex* (*canescens?*) and other woody material identifiable only to family. The former is a very common shrub of the area today. The *Atriplex* wood was found in stratum I, while the other material came from strata II, III, IV and VI.

Suaeda suffrutescens *S. Watson* in Proc. Amer. Acad. 9 (1874) 88.

In strata I and V were found twigs of this plant.

Amaranthaceae

Amaranthus blitoides *S. Watson* in Proc. Amer. Acad. 12 (1877) 273.

One specimen was found in stratum V.

Amaranthus hybridus *Linnaeus* Sp. Pl. (1753) 990.

This species was found only in stratum I.

Amaranthus Powellii *S. Watson* in Proc. Amer. Acad. 10 (1875) 347.

This is one of the most common plants in the deposit and is represented by material from strata II, III, V and VI.

Amaranthus sp.

A specimen of *Amaranthus* from stratum IV was too fragmentary for specific identification.

Plant remains representative of the centrosperms were found repeatedly in the Bat Cave excavation, probably because of their usefulness as food in an area where there is no surplus of wild food plants. Here again similarity to the present vegetation in the area of Bat Cave is apparent.

Saxifragaceae

Ribes spp.

Ribes (*aureum?*) wood came from strata I, II and IV, while two specimens of *Ribes*, unidentified as to species, were recovered from strata I and VI.

Rosaceae

The family *Rosaceae* is represented by a single specimen of wood from stratum I.

Leguminosae

Oxytropis sp.

Seedpods of this plant were found in stratum V.

Rutaceae

Ptelea sp.

A single specimen belonging to the genus *Ptelea* occurred in stratum V.

Rhamnaceae

Rhamnus sp.

Stratum V also yielded one specimen of the genus *Rhamnus*.

Cactaceae

Opuntia sp.

Numerous joints of prickly pear were found throughout the deposit from stratum III upward.

Asclepiadaceae

Asclepias sp.

Milkweed stems and pods were found in quantity in strata V and VI.

Solanaceae

Lycium sp.

Desert-thorn is represented by leaf remains from strata IV, V and VI, and by twigs from stratum IV.

Labiatae

Monarda sp.

Several fruiting heads of this plant came from stratum VI.

Cucurbita foetidissima *HBK.* in Nov. Gen. et Sp. 2 (1817) 123.

Remains of the fruit of this species were found in strata IV and VI.

Eupatorium sp.

Stems with leaves and involucral bracts were found in strata IV and VI.

Artemisia spp.

Numerous flowering stems of a sage brush were recovered from strata IV, V and VI. One specimen of wood which is probably an *Artemisia* came from stratum IV.

Pericome caudata *A. Gray* Pl. Wright. 2 (1853) 82.

In stratum V a number of heads of this composite were found.

Aplopappus gracilis (*Nutt.*) *A. Gray* in Mem. Amer. Acad. ser. 2, 4 (1849) 76.

In stratum VI two stems of this plant were recovered.

Verbesina sp.

Heads identified as belonging to this genus came from stratum VI.

The composite family was well represented in strata I, III, IV and V by wood material identifiable only as to family. The composite remains are in no way unusual as they represent only forms which grow in the area at the present time.

Altogether the plant remains from Bat Cave comprise

19 families and 39 genera. Although the selection of these plants was entirely dependent upon the needs of the people, it nevertheless provides us with a fairly satisfactory record for several thousand years of the vegetation in the Bat Cave area.

As has been previously noted, the vegetation during the period of the occupation of the Cave was remarkably similar to the present day vegetation. Three species present today are represented from stratum I to stratum VI, and five additional species are represented from stratum II to stratum VI. These plants include *Pinus edulis*, *Juniperus pachyphloea*, *Sporobolus airoides*, *Bouteloua hirsuta*, *Juglans major*, *Quercus grisea*, *Amaranthus Powellii* and *Helianthus annuus*. All of these, with the exception of the *Juglans*, are represented in the area today. Moreover, species of *Opuntia* are represented from stratum III to stratum VI, further emphasizing the similarity to modern climatic conditions.

On the other hand, there are some evidences for a slightly higher rainfall in the area during the Bat Cave occupation. The persistent presence of *Juglans major* may mean that it once grew in the vicinity. To the author's knowledge, the nearest walnut trees at the present time are about 25 miles away in the Tularosa Mountains. It could have been traded in just as easily. But the presence of *Typha latifolia* in strata IV and V, and *Scirpus validus*, *Scirpus Olneyi* and *Populus tremuloides* in stratum V can only reasonably be explained by a nearby body of water. At the present time, pools of water remain on the playa for many days during the summer rainy season. A better distribution of this rainfall throughout the year, together with a slight increase in the average annual precipitation, would result in a permanent shallow lake on the playa in front of Bat Cave. The number of acorn shells in stratum III may

also indicate a higher precipitation and thus a greater abundance of oak in the area at the time of the stratum III occupation. The necessity for an adequate water supply during the period of Bat Cave occupation must have meant a higher precipitation, as there is no permanent source of water nearer than the springs at T.U.T. Ranch and Jacks Peak about twelve miles across the plain from Bat Cave.

At the present time flood water farming in nearby canyons would be possible only in years in which the rainy season started relatively early. In the summer of 1948, the rainy season did not begin until about July 15. This probably would not permit a sufficient growing period to mature maize, beans or squash before the fall frosts at this altitude (6500 feet above sea level). Thus, again it seems probable that the Bat Cave people had a permanent water supply or that the annual precipitation was more favorably distributed throughout the year.

The remainder of the Bat Cave plants are of no importance as climatic indicators. All of the genera grow in the area today, but their characteristics of growth give no indication of past conditions.

From the nature of the plant remains we may assume that the Bat Cave people practiced a subsistence agriculture supplemented by gathering wild plants as their fruits matured, or as the need for various plants arose. No evidence of extensive storage was encountered in the excavation.

The subject of dating the Bat Cave deposit has been purposely omitted thus far. Suffice it to say, Dr. Ernst Antevs has studied the local geology. Although it was reported in an earlier publication (Mangelsdorf and Smith, 1949) that the cultural deposit from which the plant remains were recovered could not have begun more recently than 2500 B.C., Antevs now feels that this

material could not have been deposited previous to about 2000 B.C. This point in time is established by the upper limit of a thin dust layer upon which the plant-bearing deposits rest. The upper limit has been tentatively dated by Mr. Dick as 500 to 1000 A.D. These latter dates are based upon pottery fragments from the upper 18 inches of the Bat Cave deposit.

Additional evidence as to the age of this deposit is also available. Vegetal remains from the Bat Cave deposit were sent by Professor P. C. Mangelsdorf to the Institute for Nuclear Studies at the University of Chicago where radio carbon dates were assigned. These vary from 1752 ± 250 for stratum VI to 2862 ± 250 for stratum II. The material from stratum I was insufficient to obtain data. By extrapolation, however, it would appear to be 3000 to 3500 years.

Thus, stratum II, for which the earliest date was obtained, may contain material deposited as early as 1162 B.C. or as recently as 662 B.C. Should the earlier material (stratum I) be 3500 years old, the deposit could have been started about 1550 B.C. This date agrees satisfactorily with the geological date furnished by Dr. Ernst Antevs.

Summary

1. Cultivated squash (*Cucurbita Pepo*) is present throughout the Bat Cave deposit.

2. Cultivated beans (*Phascolus vulgaris*) are found only from stratum III upward, and then only in small quantities.

3. Wild vegetal remains indicate semixerophytic vegetation in the past similar to the existing vegetation near Bat Cave.

4. Remains of plants requiring a permanent body of shallow water (*Typha latifolia*, *Scirpus Olneyi* and

Scirpus validus) indicate a higher amount of precipitation than at present for the time represented by stratum V and possibly for stratum IV.

5. The presence of cultivated plants (maize, squash and beans) and *Juglans major* also indicate a higher annual precipitation during the time of the Bat Cave occupation.

6. The abundance of acorns in stratum III may indicate a higher precipitation at that time.

7. The Bat Cave people probably practiced a subsistence agriculture supplemented by gathering wild plant materials.

PLANTS OF BAT CAVE

	I	II	III	IV	V	VI
Zea Mays	X	X	X	X	X	X
Cucurbita Pepo	X	X	X	X	X	X
Phaseolus vulgaris			X	X	X	X
Helianthus annuus	X	X	X	X	X	X
Pinus edulis	X	X	X	X	X	X
Pinus ponderosa					X	X
Pinus sp. (wood)		X	X	X	X	X
Juniperus pachyphloea		X		X	X	X
Juniperus sp. (wood)				X		X
Typha latifolia				X	X	
Festuca Kingii						X
Poa Fendleriana				X	X	X
Poa secunda			X	X		
Elymus salina						X
Sitanion Hystrix						X
Trisetum Wolfii				X	X	X
Calamagrostis inexpansa					X	X
Muhlenbergia rigens				X		X
Sporobolus airoides		X	X	X	X	X
Sporobolus Wrightii			X	X	X	X
Bouteloua gracilis		X	X			

	I	II	III	IV	V	VI
Bouteloua hirsuta		X	X	X	X	X
Sorghastrum nutans					X	
Scirpus Olneyi					X	
Scirpus validus					X	
Scirpus sp.				X		
Yucca baccata		X	X			
Yucca spp.	X	X	X	X	X	X
Populus tremuloides					X	
Juglans major	X	X	X	X	X	X
Quercus Gambellii					X	X
Quercus grisea		X	X	X	X	X
Quercus spp. (acorns)			X		X	
Quercus sp. (wood)			X			X
Chenopodium sp.				X		
Atriplex canescens				X		X
Atriplex (canescens?) (wood)	X					
Suaeda suffrutescens	X				X	
Chenopodiaceae (wood)		X	X	X		X
Amaranthus blitoides					X	
Amaranthus hybridus	X					
Amaranthus Powellii		X	X		X	X
Amaranthus sp.				X		
Ribes (aureum?) (wood)	X	X		X		
Ribes sp. (wood)	X					
Rosaceae (wood)	X					
Oxytropis sp.					X	
Ptelea sp. (wood)					X	
Rhamnus sp. (wood)					X	
Opuntia sp.			X	X	X	X
Asclepias sp.					X	X
Lycium sp.				X	X	X
Monarda sp.						X
Cucurbita foetidissima				X		X
Eupatorium sp.				X		X
Artemisia sp.				X	X	X
Artemisia sp. (wood)				X		
Pericome caudata					X	
Aplopappus gracilis						X
Verbesina sp.						X
Compositae (wood)	X		X	X	X	

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THE STORY OF PAN CHEWING IN INDIA

BY

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INTRODUCTION

"There are so many ways of doing everything, all over India." This is particularly true of pan or betel chewing, not only in India, but in all the Eastern countries where pan has entwined the culture and conventions of the people. Even the name pan has acquired a new connotation in India. It originally meant betel leaf. In modern writings and usage, however, pan refers to both betel nut and betel leaf; thus in Hindustani *pan dena* means the custom of giving betel nut and betel leaf, and in South India *tambula kodi* conveys the same meaning. The origin of its use fades into antiquity and is lost in the dim past of the prehistoric periods.

The chief constituents of pan are betel nut, betel leaf and quicklime, the inevitable three apices of the pan triangle; Forster calls them "pan's trinity." The other materials used with them are merely ingredients.

The use of pan, a civility, a hospitality, a convention, a habit, and an innocent after-meal breath-sweetening practice, has often been treated in sweeping generalizations based on partial and imperfect facts. A practice and habit that involves over one third of the human race,

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in India, Burma, Ceylon, Malaya, Indonesia, the Philippines, the Pacific Islands as far as Fiji and the Marquesas, China, Indo-China, Siam, East Africa, Arabia and Persia, and is so intimately interwoven with millions of individuals from birth to death, in joy and sorrow, in respect and contempt, in friendship and enmity, and in challenge and honour, must be looked into from all angles.

Leaving aside the botanical and chemical analysis of betel nut and betel leaf and the works of early writers, the opinion expressed or written about pan by many recent European writers has not been wholly true; the custom has been exaggerated or represented as something abhorrent to Westerners. The reasons for these sweeping generalizations, based on partial or imperfect facts, that impressed me most on going through many of these writings about pan are: (1) unfamiliarity with the use of pan in any form; (2) judging with the preconceived idea that anything the East does is something strange, curious, mystic, or bound up with religion; (3) lack of knowledge of the background of the culture of the people and their food. Any one of these would be sufficient to colour the author's conclusions.

The reasons for the use of pan are lost in antiquity; one's own ideas are as good as any others. In the East, it is said to be because of the carminative effect, to keep the gums and teeth strong, to aid digestion, to sweeten the breath, or for something to chew after meals, or a good practice by which to circumvent narcotic temptation. One of the very early writings, the Indian "Hitopades" (friendly advices), notes about thirteen properties of pan; it removes bad odour; it expels phlegm; it expels flatulence; it expels worms; it beautifies the mouth; it helps digestion; it is sour; it is bitter; it is heating; it is sweet; it is salt; it is astringent; and it excites de-

sire. Marco Polo speaks of it as "salutary." One reason that strikes me is this: coffee was introduced into India only about 200 years ago, and tea might have been a little earlier; but even now tea and coffee do not form a part of all meals. Lunch or dinner or feast meals are ended in many cases with curds, buttermilk, milk or sweets. In all cases, however tasty or flavoured the food may be, the food or beverage taste is gotten rid of from the mouth after the mouth is washed. It is generally after the meal and mouth-wash that pan or a piece of nut, or a mixture of nuts is used to sweeten the breath. This habit of the aftermeal use of pan or a piece of nut is the most common practice that one comes across in India. Garcia da Orta noticed this practice about 400 years ago. "Among these people [Indians] it is so detested to smell bad." "Everyone chews it [pan] after meals." "Many Portuguese say that when they eat fish, they alternate it with betel." Forster writes, "their [pan chewer's] breath is sweet; they are the exact antithesis of Italians, and crowd for crowd I would rather be with them [pan chewers]."

In all cases of pan chewing up to the beginning of the 17th century, and in the majority of cases now, the pan was and is used to eat and swallow for its acquired taste, and the colour in the mouth is rinsable, leaving no stain on the teeth after washing.

After tobacco was introduced into India by the Portuguese somewhere in the 16th century[1] and its use in

[1] Baber in his Memoirs for 1519–1525, describing all the useful plants and animals of India, makes no reference to tobacco. Garcia da Orta lived in India from 1534 to 1564, and in his classical works on Drugs and Simples of India, makes no mention of tobacco. "Doubtless to the Portuguese is due the credit of having conveyed both the plant and the knowledge of its properties to India and China. It is said in the Dara-shikohi that they had conveyed it [tobacco] to the Deccan as early as 1508" (Watts). Asad Beg, in 1605, found some tobacco

India and China became widespread during the 17th century, a new form of pan chewing developed, that is, chewing betel nut and betel leaf with lime and tobacco, but only to keep it in the mouth for its effect. Nothing is swallowed or eaten in this type of chewing; the red saliva is spit out as often as it collects in the mouth; the mass of chewed pan with tobacco remains in the mouth; finally, when the tobacco loses its effect, the whole mass is spit out. This detestable habit of chewing has been described as causing "the ghastly marks one commonly sees in the streets." The blackening of teeth is mostly noticed among this class of pan chewers due to their negligence in cleaning their teeth. In this method, the pan is only an accessory or an accomplice to the tobacco habit. All the low grade nuts and leaves are used up by this class of chewers: the spicy and aromatic ingredients used by the majority of chewers for taste are not used by those who chew pan for the tobacco habit. Before tobacco introduction, chewing was entirely to eat and swallow, and spitting was rare, and even those who used kath, spit out only the first saliva, if any; the rest was chewed and eaten. Garcia da Orta has noticed this: "They spit out the first juice .... some persons do not do this but chew it all and afterwards take other leaves in the same way."

Out of about 30 plant products which are used in some form or other in chewing pan, only the betel nut (with the exception of tobacco) contains alkaloids. There are several of these, the most active principle being arecoline $C_6H_{11}O_2N$ (about 0.1%). Besides alkaloids, the nut contains: Moisture: 31.3%; Proteins: 4.9%; Fats: 4.4%; Carbohydrates: 47.2%; Minerals: 1.0%; Cal-

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in Bijapur and took it to the Emperor Akbar who attempted to smoke." .... Comes affirms that the seed cultivated in India in 1605 had been brought from Brasil." (Watts)

cium: 0.05%; Phosphorus: 0.13%; and a trace of Iron: 0.5 mg. per 100. Cured nuts are considered to be of the highest quality. The curing improves the colour and taste and removes the excess of tannin and mucilage in the nut. Raw nuts contain 21.6 to 30.2% of tannin, whereas cured nuts only have 8.6 to 15.1%. Cured nuts are more commonly used in southern India than in northern India.

The betel palm and vine have been variously described in Indian literature; the areca palm has been called "an arrow from heaven"; and poets have often symbolized the palm and vine for enduring strength and beauty.

History, Botany and Cultivation

a. Betel Palm: *Areca Catechu* L.

The genus name *Areca* is of South Indian origin. Among the Nairs, *Areca* means "cavalier." In Kannada[1] the betel palm is called the *Adike* tree, the nut *Adike*. The specific epithet *Catechu* is probably from *Kachu* meaning in Kannada "astringent substance."

The original home of the betel nut palm is uncertain, as it is so widely cultivated in all the tropical parts of Asia and in all the islands of the Indian and North and South Pacific Oceans (see map). It has as many distinct names as there are languages in the East. It is not found wild anywhere in any of the countries of its cultivation. Its numerous varieties, the many distinct names, and the lack of wild individuals all indicate its antiquity, but do not solve its origin. Several different opinions have been expressed by botanists as to the original home of the betel palm: Martius is uncertain, but thinks it is probably native to the Sunda Isles; Blume, Bretschneider and Ridley consider it to be Malayan; Miquel and Blanco

[1] Kannada is one of the major languages of South India. I am not sure which is the older term, i.e., whether *Areca* is derived from *Adike* or vice versa.

EXPLANATION OF THE ILLUSTRATION

PLATE XLV. A fruiting branch of the betel palm (*Areca Catechu* L.) showing some of the fruits or nuts in section. Betel nuts are one of the chief ingredients of pan or betel chew.

From a painting by BLANCHE AMES.

Plate XLV

do not seem to agree with them. Blatter claimed to have received a letter from Fischer stating that he found in the Attapadi Valley of Malabar, South India, the areca palms growing wild in dense evergreen virgin forests. Beccari's reasoning seems to be more plausible; he considers that *Areca Catechu* var. *silvatica* is very closely related to the cultivated palm, and this variety is found wild only in the Philippines, and nowhere else. In addition to this variety, there are many Areca species found wild in the Philippines which closely resemble the cultivated plant. On these evidences, he thinks, the cultivated species probably originated in the Philippines.

The betel palm is a slender and graceful tree with a strong columnar stem surmounted by a crown of pinnate leaves. The straight, cylindrical, greyish trunk attains a height of over sixty feet. From base to crown it tapers imperceptibly and bears regular, faint rings of scars of fallen leaves. The leaves are four to six feet long; the lower portions of the petiole expand into a broad sheath and cover the stem before falling off. The upper young pinnae are confluent and stick out straight in the center of the crown. The inflorescences are found on the stem below the leaves, in the axes of old-fallen leaves; the inflorescence is a spadix enclosed in a spathe and consists of a much branched rachis bearing male and female flowers. The fruit is ovoid or oblong according to the variety, about the size of an egg, two inches thick and two and a half inches long. Before ripening, the fruits are lustrous green; when quite ripe, they turn to orange-yellow. The pericarp is fibrous and husky. The seed, or kernel, consisting of hemicellulose endosperm, is the "nut" used for mastication. The tiny embryo at one end of the nut drops off on drying or during the process of cooking. The uncured (uncooked) nut is greyish brown in colour, and when cut, shows reddish brown lines of albumen.

There are numerous varieties and many nuts of quality are known by local names and fames all over India.

The betel palms are cultivated in pure-stand plantations or in mixed gardens along with coconut palms, bananas, oranges, limes, mangos, guavas, and numerous other side plants of economic importance. It is a maritime palm, and requires a tropical climate for luxurious growth. Its requirements are more or less the same as in the case of the coconut, but it is very sensitive to drought. In the tropics it grows well where there is a heavy rainfall or under irrigation; it requires shade in its early stages. It grows in a variety of soils from the laterite soils of the west coast of India and Ceylon, through Deccan along the east coast, to the alluvial soils of Bengal and Assam, extending to Burma, Siam, Indo-China, China and the islands of the North and South Pacific Oceans.

Seedlings are raised in shady nurseries and transplanted at an age of two or three years; seeds are also sown directly by dibbling the seeds in holes about 6–8 feet apart. In Bengal, the first row of seeds is dibbled under the shade of *Erythrina indica* (the latter put in rows as cuttings at 12–15 feet apart) and when the palms begin to bear, the Erythrina plants are cut off and in their place, and under the shade of the older palms, new rows of seeds are dibbled. Bearing begins when the palms are about 7–10 years old, but the plantation comes to full bearing when it is about 15–20 years old and continues to yield for from 30 to 60 years. The palms live over 100 years under good soil and cultivation.

b. Betel Vine: *Piper Betle* L.

The generic name *Piper* is probably a derivative from the Sanskrit word *Pippali* for pepper. The name betel (betle), meaning "simple leaf," seems to come from *betre*

from the Malayalam language in South India. As in the case of the betel palm, the betel vine has distinct names in the various Indian languages. The betel vine, or pan as it is sometimes called, is considered to be, probably, a native of Java. Some even consider it to be indigenous to South India, Ceylon and Malaya. Marco Polo, in his travels, had seen betel leaves in Madras. Ibn Batula has described both the betel nut and betel leaves; of the latter he writes: "a plant that grows like a grape vine. It is trained over a trellis of canes like a vine or plants near the coconut palm, where it clambers up like a vine or pepper. It does not bear fruit; but it is the leaves which are used and they are like those of the Bramble." It is extensively cultivated in India, Ceylon and Malaya. Marco Polo mentions this leaf: "that people of India have a habit of keeping in the mouth a certain leaf called Tembul." (The Sanskrit name is *Tambul;* the Kannada name *Tambula.*) And he further comments: "that the rich people and the King have these leaves prepared with camphor and other aromatic spices, and quicklime." Many other European travellers and others have noted the use of betel leaf. Garcia da Orta has discussed the use of pan in detail. "That Indians are in the habit of keeping the nail of the right thumb pointed and sharp, in order to remove the mid-rib of the leaf." The leaves are used in the green and tender state.

The betel vine, a pepper, is an evergreen perennial, twining on living supports—areca palms, species of *Erythrina*, *Sesbania*, etc. It has a heart-shaped, simple, exstipulate leaf, light green to deep green in colour, with five to seven dorsally well marked veins.

Among the horticultural and agricultural plants which need human care, the most cared for and the one which is given the most delicate attention, is this vine. No other plant seems to have so much tender and considerate

EXPLANATION OF THE ILLUSTRATION

PLATE XLVI. (Upper figure). Different types of beeda, the commercial form of ready-made betel chew. *Left*, northern India; *center*, Philippine Islands; *right*, Siam.

From a painting by BLANCHE AMES.

(Lower figure). Map showing the area of cultivation of the betel palm, and the distribution of the betel-chewing habit.

Plate XLVI

Area where the Betel-nut palm is cultivated
Limit of use of Betel-nuts.

attention by the cultivator. A worker in the vineyard often reminds one of a servant in a palace, too careful to spoil anything. For the successful growing of this vine, one must need to have perfect knowledge of its requirements — adequate wind breaks, protective shade with diffused light, perfect supports, rich and well-drained humus soil, fairly constant temperature with a uniform amount of moisture and regular manuring at intervals. In some parts of India the vine is grown in specially constructed houses of grass, reeds and mats, having flat grass roofs so arranged as to admit diffused light.

As in the case of the betel nuts, there are numerous, localized varieties of leaf; and in some details the cultivation varies from place to place. The vine is rarely grown by the consumer, as it requires expert knowledge; hence in India, the betel leaves travel long distances from the cultivators to the consumers, i.e., to towns and cities.

Harvest and Preparations

a. Betel Nuts

The period from flowering to fruit ready to be harvested is nine to ten months. Flowering commonly occurs throughout the year. The harvesting periods in India begin in August and run up to the following January, the peak periods occurring mostly from October to November.

For curing purposes, the fruits are collected just before they are quite ripe. When one or two fruits in a bunch begin to turn orange-yellow, the bunch is cut off and the fruits are gathered. For raw nuts, all the fruits are allowed to ripen to an orange-yellow colour.

The harvesting process is of interest. Special tree climbers are employed for gathering the fruits. These are the artisans of tree climbing. The climber uses a two

to two and a half foot rope or banana fiber. This rope or plantain fiber is tied together at the ends and twisted into somewhat the shape of a figure eight in a horizontal position. The climber places a foot in each loop; the free ends of his feet with his toes and the twisted middle portion of the rope serve to clasp the cylindrical stem like a clip. He first holds the stem with his hands, clasping the stem at his chest level, and pulls his legs up with the looped rope in his feet; at this level, he clasps the stem with his feet and the rope, releases the hold of the hands and pulls the whole length of the body up; then again holds the stem with his hands, releases the hold of the feet and pulls the legs up. These alternating holds and pulls each time cover over two to three feet of the stem. The climbers are so brisk and agile, that in seconds they will be at the crown of the tree of sixty to eighty feet in height. They go from tree to tree by swinging and catching the next tree, as the areca palms are slender and flexible, until the day's harvest is completed and without climbing down. It is easy to take a swing, if one is bold enough, on an areca palm, but it is not possible on coconut palms as they are not slender and flexible. Once on the tree, the climber knows by experience which branch to cut and which not to cut. He removes the bunch and allows it to drop on the ground. The bunches are then collected. Often if there is thick vegetation below, the branches are caught in nets or lowered down by means of a rope.

Semi-ripe fruits, that is, fruits to be used for curing, are easy to husk. The pericarp is cut into halves without bruising the seed and this is done by means of sickles or special sharp blades fixed into a plank. One end of the fruit is pushed against the blade, and when the blade enters half way into the pericarp, and before it reaches the seed, the fruit is pushed sideways which splits the

pericarp into two parts and the seed drops out. This shelling is done when the fruits are fresh and before they dry up.

The curing process consists of boiling or cooking the seeds. The shelled seeds are placed in copper or earthen vessels with enough water to cover the seeds. For the first charge, a small quantity of the previous year's extraction, a decoction called *chongaru*, is added; or in the absence of *chongaru*, a few pieces of the fresh bark of *Syzygium Cumini*, *Pterocarpus santalinus*, *Ficus religiosa*, or other trees. Nobody seems to have considered why these barks or *chongaru* are added to the first charge. They may be likened to catalytic agents in chemical reactions, and I suppose they are added to aid the tannin reaction and the release of the same in the process of cooking. In some cases a small quantity of sesame oil is added. The charge is then heated to the boiling point. The seeds are boiled until the tiny embryo drops out and then they are removed by means of perforated ladles and are dried for about a week. There are various modifications in this process of cooking. Unhusked fruits may be boiled and then husked, sliced and dried; or the seeds after husking may be cut into halves and cured, or sliced into smaller pieces and then cured. Sometimes various spices and jaggary are added during the boiling process to increase the taste and aroma of the nuts. "Occasionally the kernels are reboiled in milk to cater to fastidious tastes."

After three or four charges have been boiled in the same decoction, the extract becomes semi-liquid; on drying, this becomes a solid substance which is sold as kath (cutch).

Seeds which are left whole during drying are called *unde-adike;* the ones that are cut into cup-shaped halves and dried are called *battalu adike;* those that are cut

into smaller pieces and dried are called *churu-adike*, or *lavanga-churu*. Thus the nuts are sold under different names which vary according to whether they are uncut whole nuts, or are cut into halves, or into smaller pieces. This curing or cooking process is practiced throughout India, particularly in Mysore and other parts of south India.

The preparation of raw nuts in other nut-growing countries is the same as in India.

Malaya produces four kinds of nuts: 1, whole nuts. 2, split nuts. 3, sliced nuts and 4, smoked nuts, and also salted nuts in small quantities. Briefly some of the methods followed in Malaya are as follows:

Pinang kossi. Ripe fruits are dried in heaps with occasional turning for about three months before husking; after husking, the seeds are dried again for two or three days before packing and marketing.

Pinang blah. Ripe fruits are split into halves and dried with the split sides uppermost for two or three days. After the husk is removed, the seeds are dried again for two or three days before marketing.

Pinang salai (smoked nuts). The smoking process is done in a specially constructed mud oven with bamboo gratings. The ripe fruits are placed on top of the bamboo gratings and a fire is developed inside the oven with dry betel-nut husks, the smoke of which escapes through the mass of fruits; this smoke continues for about a week before the fruits are taken out. They are then husked and the seeds are dried for two to three days before marketing.

Pinang asin. Semi-ripe green fruits are mixed with salt and stored in sacks for two to three months before husking. The fruits are then husked and the seeds dried for two to three days before marketing.

b. Betel Leaf

Betel leaves are harvested throughout the year in rotation, as the vine is evergreen and perennial. The leaves are generally picked in the morning. They are picked with at least one half inch of the petiole attached to the leaf. Then these leaves are serially arranged one above the other, the ventral surface of one lying on the dorsal surface of the other and the petioles touching side by side. Counting of the regularly arranged petioles is the method adopted to count the number of leaves. The leaves are counted in 20's, 100's and 500's. In this arrangement the leaves, alternating with banana or plantain leaves, are packed into ball-shaped or barrel-shaped large bundles, an operation which requires experienced hands. Thus packed, they can withstand any amount of handling and any distance of travelling. These artfully packed leaves often travel long distances from the place of cultivation to towns and cities, often on head loads, on busses or in trains.

Besides supplying city and town markets, the betel leaves are sold in the interior parts of India on a barter system. Venders (usually women) carry leaves to each village on alternate days or twice a week, and cater to the village families and collect grains during harvesting seasons.

Other Ingredients

a. Kath (cutch)

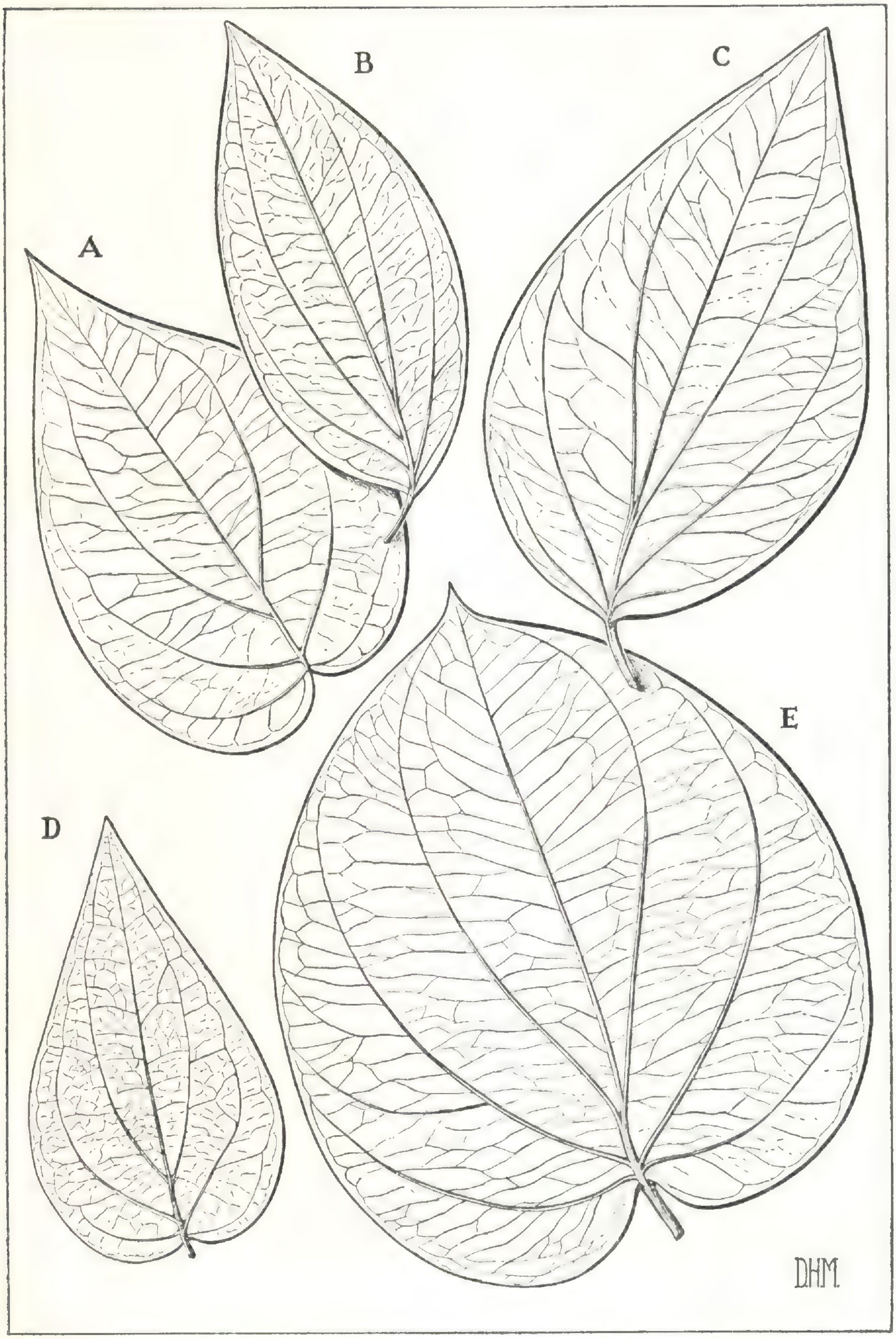
There are several types:

1. Kath from *Acacia Catechu* wood (pale catechu). This is the crystalline substance prepared from a concentrated decoction of *Areca Catechu* wood. The chipped wood of this plant is boiled in water to concentration and the decoction is then cooled to get the crystalline

EXPLANATION OF THE ILLUSTRATION

PLATE XLVII. Leaves of the betel pepper (*Piper Betle* L.), the second of the principal ingredients of betel chew, obtained in various Asiatic markets, and showing variation in shape. A and D, Manila, Philippine Islands; B and C, Bombay, India; E, Bangkok, Siam.

Plate XLVII



thick brown substance which is cut into blocks and sold as kath by druggists. These cubes or blocks are redissolved in hot water and cooled into a semi-liquid for use with pan; or the cubes are cut into small pieces and used as such.

2. Kath, white kath, or gambier, from *Uncaria Gambir*. The leaves and twigs are boiled in water and the concentrated decoction is then cooled to get a crystalline substance. This is cut into cubes or blocks and sold in the market. The cubes are redissolved in water into a semi-liquid for use with pan.

3. Kath from *Areca Catechu* seeds. As already described under nut-curing, a semi-liquid is obtained by boiling several charges of seeds. This *chongaru*, on drying, can be cut into blocks or cubes to be sold as kath.

b. Tobacco

There are various preparations of tobacco for use with pan. The tobacco used is a strong-smelling country-cured tobacco with each leaf pressed into a sticklike form. It comes to the market in small bundles.

1. *Khaina*. A thin layer of lime is applied to the left palm and the chewing tobacco is rubbed and pressed with the right-hand thumb which has also a thin layer of lime. This pressed lime-tobacco is then placed in the mouth over the chewed pan. This limed tobacco is called *khaina*.

2. *Jharada*. This is tobacco chewed with pan and other ingredients and is used mostly in northern India.

3. *Tombacu*. In Hindustani, *tombacu* means tobacco. The country-cured tobacco is powdered and moistened with gur (jaggary) dissolved in water. It is variously pressed and often is made into grain-like form for use in

the pan. It is frequently covered with gold or silver leaf, and is the most expensive form of tobacco.

4. *Kaddipudi.* This is the cheapest form of tobacco. It consists mainly of the stalks and the petioles of tobacco plants. These sticky parts of the plants are crushed into a coarse powder (*kaddipudi* means powdered-sticks), processed with jaggary and water, and pressed into bricks or blocks and sold in the market.

5. *Gundi.* This is a mixture of country-cured tobacco, coriander seeds and other spices. The tobacco is powdered and fried; coriander seeds, and other spices, are each fried until they have the correct smell and are then coarsely powdered and mixed; finally the whole mixture is scented with a resinous oil called *chua; gundi* is known as *kadapan* in Orissa and Bengal.

c. Amber and lime

Amber. Amber is a fossil resin, but the term is also loosely applied to many resins from living plants. It is used to give an aromatic smell to pan.

Lime (quicklime). Originally lime for use in pan was made from burned shells; but now it comes from burned limestone; i.e., from calcium carbonate. Calcium carbonate is burned in special kilns, and is converted to calcium oxide. On the addition of water, this calcium oxide is changed to calcium hydroxide, which is known merely as lime or quicklime, and is used in pan. Precaution is always taken not to dry the lime completely in the open atmosphere, as it will be partially reconverted to calcium carbonate and become hard. Often the lime is variously scented with camphor, or colored with saffron, and bottled for sale. However, the plain lime is the form found to be in most use. Each family buys its own stones and prepares its own lime. The pan chewers carry their lime

in small metal containers or in small glass containers called *sunnadu-dabbi* (lime-container).

The purpose of using lime with the leaf is to neutralize the burning and stinging acidity in the leaf. A leaf taken without lime burns the mouth, and one gets a terrible stinging sensation. That is why, knowingly or unknowingly, the pan chewers always use lime and smear the leaf with it before placing it in the mouth. If an excess of lime is used, the effect would be the same, as the lime will also burn the mouth. This is one precaution, not to take a leaf without lime and not to use an excess of lime, which the pan chewer knows by experience. Generally the amount of lime applied to the leaf is very small.

Utilization of Pan

a. Non-habitual chewing

In this type of chewing the pan is eaten entirely for the carminative and salutary effect. Four different methods are used.

1. Pan trinity. Used either plain or with ingredients (*masala*), this is the simplest form of pan. It varies depending on a liking for astringency or sweetness. For astringency, raw nuts are used; for sweetness, cured nuts. The nuts are first placed in the mouth. While they are softening, the leaves are cleaned, and the lime is applied to them. They are then folded into small size and placed in the mouth and chewed with the nuts which are already in the mouth. The number of leaves used varies, but on the average a person may use from three to five leaves at a time. This form of chewing thus consists only of betel nuts, betel leaves and lime. Some use various other ingredients during the process of chewing; with cured nuts, people who like the sweet taste may use pieces of

copra, cardamom seeds, cloves, nutmeg and mace; the astringent loving ones use kath and cardamom seeds. There is no hard and fast habit in these usages; one may use only cardamom seeds with pan; or only cloves. They often depend on the economic condition of the users, as the ingredients, unlike pan, depend on the buying power of the users.

Various kinds of pan boxes are used in northern India to keep these pan trinities and their ingredients. These are of various shapes, and often exquisitely ornated. They are mostly made of brass and are divided into compartments where the ingredients are placed. The boxes are circular, with the compartments radiating, or rectangular; often they are two-storied, the upper story, which has compartments, is fitted into the lower one; this upper one can be lifted out. The lower story, without compartments, contains the nuts and often a small nut slicer.

In southern India, the pan is offered on special plates; in rich families on silver plates. The betel leaves are arranged on the plates, the nut mixture is placed in a silver cup or in a glass bottle which is placed to one side, with the lime in a small glass container or on a betel leaf; the plate is then placed before the guests and relatives after the meals.

2. Nut mixtures (*pudi-adike*). The nut mixtures also differ in their ingredients depending on whether cured nuts or raw nuts are used. Further, they differ in the number of ingredients, aroma and freshness, depending on whether they are prepared by the housewife for home use or are commercial products, and also on the buying capacity of the user.

Cured nut mixtures. An average middle class well-to-do family uses a nut mixture prepared in the following way. Generally half nuts are broken into coarse pieces.

To these grated copra, grated nutmeg, crushed cardamom seeds, broken pieces of cloves, broken mace, tiny pieces of cardamom or cassia bark and saffron are added and mixed well. The fresh grated copra gives a fatty coating to the whole mixture and increases the aroma. Crystals of sugar are then added. This mixture is always kept in air-tight bottles to preserve its freshness. Occasionally a very small quantity of camphor may be added to increase the smell. The same kind of mixture, sometimes varying in ingredients, is prepared by small firms, or restaurants, or pan shops for use in beedas; or for use after a meal; often the mixture may further be scented with amber or other resins. The mixture is placed in small paper packages (each package contains a small spoonful of mixture) and sold in the shops. Some restaurants keep these packages at the counters for the use of the customers after meals.

Raw nut mixtures. The raw nuts are sliced, and fennel seeds, caraway seeds, coriander seeds, cardamom seeds, and broken cloves are added to them. The number and kinds of seeds used vary very much in this mixture. In northern India, hotels and restaurants very commonly keep this mixture at the counter for the use of customers. Many who may not like to chew the leaves use this mixture.

3. Beeda. This is a commercial form of ready made pan quid sold in the pan shops, in bazaars, restaurants and hotels. There are two chief kinds of beedas, in many ways different in their preparation and in their ingredients; one common to northern India and the other common to southern India.

Northern India. Each beeda contains at least two leaves. The selected leaves are cleaned, the apex and

petioles are removed, and if the leaf is large, it is split into two parts. The cleaned leaves are placed on the palm of the left hand, one above the other with the dorsal surface upward; a dash of lime is applied to it by means of a quill, and one or two dashes of kath, then some pieces of sliced raw nuts are placed in the center; a few seeds of cardamom are added, then the edges of the leaves are folded over and a clove is stuck in to hold the edges in place. It thus becomes a sort of inflated, slightly irregular-looking square. The beedas are kept arranged in trays with wet clothes to prevent drying off. They are astringent and often bitter depending on the amount of kath used. On account of the raw nuts and the kath, if this pan is taken for the first time by one unaccustomed to it, one may experience the choking effect and all the other undesirable features attributed to pan by writers. High grade beedas are often covered with silver or gold leaf.

Southern India. In southern India, tender leaves are selected for beeda, and each beeda contains at least two leaves. The apex and petiole and to some extent the mid-rib are removed, and a thin layer of one or two spots of lime is applied to the dorsal surface. A spoonful of nut mixture (consisting of cured half nuts broken into small pieces and mixed with grated copra, grated nutmeg, pieces of mace, crystals of sugar, cardamom seeds and saffron) is then added to the leaves which are rolled into a cone; the edges of the cone are pushed in and stuck with a clove. These cone-like rolls are placed in wire loops which are so arranged as to look like a green flower bouquet; or are placed in plates arranged in a pyramidal shape. These beedas are sweetish, aromatic and tasty. Anyone can eat them whether or not for the first time or by one unaccustomed to pan. There is no

astringency or bitterness in these quids. This is a very common form of pan, chewed in southern India by non-habituals, who eat it only for its taste and smell. These are all commercial forms, but most families prepare their own nut mixture and buy fresh leaves almost every day. The home-made pan in southern India is something one must taste to know what pan is really like.

4. Scented nuts. For this purpose only cured nuts are used. Half nuts are scented with amber, camphor, resins and other ground spices. These scented half nuts are each packed in paper, like lemon drops or peppermints, to keep the freshness of the nut. The half nuts are sometimes broken into two or three pieces and scented with a ground mixture, as before, of amber, camphor, resins and other spices, and to this, shelled melon seeds are sometimes added.

b. Habitual chewing

In this form of chewing, indulged in for its own effect or for the narcotic effect of the tobacco, mostly the lower grades of nuts and leaves are used. In the majority of cases, it is the poorer classes of people who have this habit. For use with tobacco, the cured nut mixture, the southern Indian beeda, and scented nuts are not utilized, not only for economic reasons, but because they do not produce any narcotic effects. The northern Indian beeda and raw nuts and also their *masala*, however, are very well suited for this kind of habitual chewing and for the use with tobacco. Ripe seeds and coarse leaves are better adapted, since fibrous leaves and ripe seeds give a coarse base and the bulk required to keep the tobacco in the mouth. It is exactly the antithesis of the non-habitual chewing where tender leaves and cured nuts are required, so that they may be dissolved, so to say, in the mouth during

chewing. In this form of chewing, mostly pan trinity is used with tobacco. Tobacco is also mixed with some spices, as in *gundi* and *jharada*.

As in the plain pan chewing, the process is the same: first the nuts are placed in the mouth, followed by leaves; generally this class of chewers use more lime than the non-habitual chewers. After the nuts and leaves are chewed a little, they use the kind of tobacco to which they are addicted; some people prefer the rashed rhizome of *Smilax calophylla*.

c. Ceremonial Utilization

To attempt to write about the ceremonial uses of betel nut and betel leaves in India in this paper may be likened to an attempt to write the cultural history of the people of India in one sentence. There is no ceremony, there is no occasion, there is not a day in an Indian's life where the pan does not play its part. The happiest part of honeymoons, the happiest part of married life is spent over pan. The young couples, on the day's work well done, retreating to their seclusion after meals, talk out their hearts and pour out their affection while the bashful young wife prepares pan quid with selected leaves. The parents, in Indian families, plan out and discuss the day's outcome of work, the family affairs, children, their education, over pan; while children cluster about grandmother to hear fairy stories at leisure over her pan.

Indian families, as a class, abhor anything narcotic, anything alcoholic, and regard them as degrading to the human soul. Even the pan, which has no narcotic effect, is not allowed to be used by children or youths at a tender age.

d. Medicinal Utilization

Betel nuts. Medically they are chiefly used in veteri-

nary practices as a vermifuge for tapeworms. Of all the alkaloids in the nut, it is only arecoline which has toxic properties. The juice of tender nuts is reported to act as a laxative when given in small doses. This decoction, in conjunction with other drugs, is used for costiveness and dyspepsia. The burned nut is said to be used as a dentifrice. A strong decoction of the ripe seeds is also used for dyeing red and black shades.

Betel leaves. The essential oils from betel leaves are used in treating catarrhal affections, inflammations of the throat, larynx and bronchi; they exert an antiseptic action, and also can be used with advantage in diphtheria. The juice of fresh leaves is diluted and given as a dose when the oils are not readily obtainable. The fresh juice, mixed with lime, is applied to the throat in glandular inflammation. Many ayurvedic medicinal pills are administered with the fresh juice of betel leaves. The leaf is smeared with oil, warmed and applied as a poultice to sores.

Economic Importance of the Palm

The betel nut palm is one of the most important economic plantation crops. The amount of nuts used in India alone give some idea of its importance. It may be safely said that about eight to ten million dollars worth of nuts are used annually in India. She imports, besides her own production, over 56,000 tons of betel nuts, and absorbs almost all the surplus of the major betel-nut producing countries like Ceylon, Straits Settlements, Indonesia, etc.

As in the case of tobacco, coffee and tea, the betel nuts are also taxed and the government gets considerable revenue out of the nuts. There are areca nut merchant associations in plantation areas to safeguard the plantation interests and to regulate production and disposal of the

nuts. But there are a considerable number of small patches of palms, grown near tanks and river sides for family use or for catering to a group of villages, which seldom come under statistics. Precise figures of acreage under the palm are thus difficult to obtain. The statistics regarding the actual acreage, total production, etc., are incomplete; the figures often given in journals and books must be taken with large margins. It is often noted that the acreage for India and Burma is as follows:

Bombay State (Province)		22,700	acres
Madras	" "	108,600	"
Mysore	" "	34,500	"
Ceylon		68,500	"
Burma		30,750	"

Bengal and Assam State (Province) greater acreage than any other states (no definite figures).

The net profit per acre is not very high. It is stated to be just over Rs. 100 per acre — an acre holds from 1,000 to 1,500 palms; each palm on the average yields about 250–300 nuts; often the annual yield per acre is up to 300 cwts. However, the yield of cured high-grade nuts is much less; in Mysore, it is stated to be only 7 cwts. per acre. The prices vary very much according to the grades from Rs. 50 to Rs. 8 per cwt.; the difference of prices between first grade quality to inferior is often as high as 5 to 1.

Conclusion

The use of pan in India has remained unchanged for centuries (except for the impact of tobacco on pan as a new form of chewing). Many of the conventional uses of pan are remembered only through practice and are handed down from parents to children. Pan is chiefly used for chewing or for social purposes, rather than as a

narcotic or a drug. Of all the masticatories, fumatories and liqueurs, the use of the pure form of pan is definitely an innocent and harmless practice.

Plants Associated with Pan

In each case the scientific name and family and the part of the plant utilized is indicated, together with the English and vernacular names.

a. Plants associated with chewing

1. **Areca Catechu** *L.* Palmaceae
   Seeds (hemicellulose endosperm).
   English: *Betel nut, Areca nut;* Sanskrit: *Gurvaca;* Hindustani and Persian: *Supari;* Malayan and Chinese: *Pinang;* Kannada, etc: *Adike.*

2. **Piper Betle** *L.* Piperaceae
   Leaves.
   English: *Betel pepper, Betel leaves;* Sanskrit: *Tambul;* Hindustani: *Pan.*

3. **Syzygium aromaticum** (*L.*) *Merr. & Perry* Myrtaceae
   Dried unopened flower buds.
   English: *Clove;* Sanskrit and Kannada: *Lavang.*

4. **Elettaria Cardamomum** (*L.*) *Maton* Zingiberaceae
   Seeds.
   English: *Lesser Cardamom;* Sanskrit: *Upakunchica;* Kannada: *Elakki.*

5. **Amomum subulatum** *Roxb.* Zingiberaceae
   Seeds.
   English: *Greater Cardamom.*

6. **Myristica fragrans** *Houtt.* Myristicaceae
   The seed and seed-cover (nutmeg and mace).

English: *Nutmeg;* Sanskrit: *Jaiphal* (Nutmeg); Sanskrit: *Jatri* (Mace).

7. **Cocos nucifera** *L.* Palmaceae

Dried kernel (copra).

English: *Coconut;* Sanskrit: *Nariyal;* Kannada: *Tengu.*

8. **Cinnamomum zeylanicum** *Breyn.* Lauraceae

Bark.

English: *Cinnamon;* Kannada: *Darchini, Dalchini.*

9. **Cinnamomum Cassia** (*Nees*) *Nees ex Blume* Lauraceae

Bark.

10. **Cinnamomum Camphora** (*L.*) *Nees & Eberm.* Lauraceae

Camphor obtained from the distillation of the wood and leaves.

English: *Camphor;* Kannada: *Karpura.*

11. **Dryobalanops aromatica** *Gaertn. f.* Dipterocarpaceae

Camphor obtained from the distillation of the wood.

English: *Borneo Camphor.*

12. **Aquilaria Agallocha** *Roxb.* Thymelaeaceae

Resins.

13. **Crocus sativus** *L.* Iridaceae

Dried stigmas and styles of the pistil. Fairly common in use.

English: *Saffron;* Sanskrit: *Kesar;* Kannada: *Kesari, Kumkumkesari.*

14. **Pimpinella Anisum** *L.* Umbelliferae

Dried fruits.

English: *Anise;* Sanskrit: *Muhuri;* Kannada: *Dodda-jirige.*

15. **Foeniculum vulgare** *Miller* Umbelliferae
Dried fruits.
English: *Fennel;* Hindustani: *Pan-muhori;* Kannada: *Saunf, Sonp.*

16. **Carum Carvi** *L.* Umbelliferae
Dried fruits.
English: *Caraway;* Hindustani: *Mita zerah.*

17. **Carum Bulbocastanum** *Koch* Umbelliferae
Dried fruits.
English: *Black caraway;* Hindustani: *Shah-zerah*

18. **Cuminum Cyminum** *L.* Umbelliferae
Dried fruits.
English: *Cumin;* Sanskrit: *Zira, jira;* Kannada: *Jirige.*

19. **Nigella sativa** *L.* Ranunculaceae
Dried fruits.
English: *Black cumin;* Hindustani: *Kala Zerah;* Kannada: *Karijirige.*

20. **Anethum graveolens** *L.* Umbelliferae
Dried fruits.
English: *Dill;* Sanskrit: *Misreys, Satapushpa.*

21. **Coriandrum sativum** *L.* Umbelliferae
Dried fruits.
English: *Coriander;* Hindustani: *Dhanya;* Kannada: *Kothamburi.*

22. **Smilax calophylla** *Wall.* Smilacaceae
Rhizome.

23. **Tamarindus indica** *L.* Leguminosae
Young leaves (rarely used).

English: *Tamarind;* Hindustani: *Amli;* Kannada: *Hunise.*

24. **Uncaria Gambir** (*Hunt.*) *Roxb.* Rubiaceae
Wood extract, Kath.
English: *White cutch, Gambier.*

25. **Acacia Catechu** *Willd.* Leguminosae
Wood extract, Kath
English: *Catechu;* Hindustani: *Kath;* Kannada: *Kachu.*

26. **Saccharum officinarum** *L.* Gramineae
Sugar from juice (stem).
English: *Sugar cane;* Hindustani: *Ganna;* Kannada: *Kabbu.*

27. **Beta vulgaris** *L.* Chenopodiaceae
Sugar from juice.
English: *Sugar beet.*

28. **Cucumis Melo** *L.* Cucurbitaceae
Shelled seeds.
English: *Melon.*

29. **Nicotiana Tabacum** *L.* Solanaceae
Leaves and stalk.
English: *Tobacco;* Hindustani: *Tombacu;* Kannada: *Hogesoppu.*

30. **Nicotiana rustica** *L.* Solanaceae
Leaves and stalk.

b. Plants associated with the preparation of pan

1. **Syzygium Cumini** (*L.*) *Skeels* Myrtaceae
Fresh bark; used in the curing of betel nuts.
English: *Black plum;* Hindustani: *Jambul;* Kannada: *Nerale.*

2. **Pterocarpus santalinus** *L.* Leguminosae

Fresh bark; used in the curing of betel nuts.

English: *Red sandalwood;* Bengali: *Rukto-chandan;* Hindustani: *Chandan;* Kannada: *Gandham, Kempugandha chekke.*

3. **Ficus religiosa** *L.* Moraceae

Fresh bark; used in the curing of betel nuts.

English: *Pipal;* Sanskrit: *Asvattha;* Kannada: *Aswat, Arali.*

4. **Sesamum indicum** *L.* Pedaliaceae

Oil from seeds; used in the curing of betel nuts.

English: *Sesame;* Hindustani: *Til;* Kannada: *Allu.*

5. **Saccharum officinarum** *L.* Gramineae

Gur (jaggary) made from juice; Gur is used in the curing of betel nuts, and in several kinds of chewing tobacco preparations.

c. Plants associated with the cultivation of pan

1. **Sesbania aculeata** *Pers.* Leguminosae

Tree serves as a supporter for the betel vine.

Bengali: *Jayanti, Jiluga.*

2. **Sesbania grandiflora** *Pers.* Leguminosae

Tree serves as a supporter for the betel vine and as a shade tree.

Kannada: *Agase.*

3. **Sesbania aegyptica** *Pers.* Leguminosae

Serves for support and shade for the betel vine.

Hindustani: *Saora.*

4. **Moringa oleifera** *Lam.* Moringaceae

Serves for support and shade for the betel vine.

Kannada: *Nugge.*

5. **Erythrina indica** *Lam.* Leguminosae
Serves for support and shade for the betel vine.
Hindustani: *Pangra.*

6. **Boswellia serrata** *Roxb.* Burseraceae
Stems used as poles to support the betel vine.
Hindustani: *Salei.*

7. **Euphorbia Tirucalli** *L.* Euphorbiaceae
Used for windbreaks and as a fence for the vine-yard.
Kannada: *Kolu kalli.*

8. **Protium sp.** Burseraceae
Used for windbreaks and as a fence for the vine-yard.
Kannada: *Konda mavu.*

d. Plants grown with pan

All are grown for their economic importance either intermingled or as a fringe plant in areca palm and betel pepper gardens or plantations.

1. **Cocos nucifera** *L.* Palmaceae

2. **Musa paradisiaca** *L.* Musaceae
English: *Plantain;* Hindustani: *Kela;* Kannada: *Bale.*

3. **Musa paradisiaca** *L.* subsp. **sapientum** (*L.*) *O. Ktze.* Musaceae
English: *Banana*

4. **Mangifera indica** *L.* Anacardiaceae
English: *Mango;* Kannada: *Mavu.*

5. **Citrus aurantifolia** (*Chr.*) *Swgl.* Rutaceae
English: *Lime;* Hindustani: *Nimbu.*

6. **Citrus medica** *L.* Rutaceae
English: *Citron.*

7. **Citrus Limon** (*L.*) *Burm.* Rutaceae
English: *Lemon.*

8. **Citrus grandis** (*L.*) *Osbeck* Rutaceae
English: *Pomelo;* Kannada: *Chakkota.*

9. **Citrus sinensis** (*L.*) *Osbeck* Rutaceae
English: *Orange.*

10. **Syzygium Jambos** (*L.*) *Alston* Myrtaceae
English: *Rose apple;* Kannada: *Pannerale.*

11. **Psidium Guajava** *L.* Myrtaceae
English: *Guava;* Kannada: *Cheape.*

12. **Punica Granatum** *L.* Punicaceae
English: *Pomegranate;* Kannada: *Dalimbre.*

13. **Michelia Champaca** *L.* Magnoliaceae
English and Hindustani: *Champaca;* Kannada: *Sampig.*

14. **Artocarpus heterophyllus** *Lam.* Moraceae
English: *Jackfruit;* Kannada: *Halasu.*

15. **Artocarpus altilis** (*Park.*) *Fosberg* Moraceae
English: *Breadfruit.*

16. **Anacardium occidentale** *L.* Anacardiaceae
English: *Cashew;* Kannada: *Geru, Godumbi.*

e. Plants used as catch-crops

17. **Zingiber officinale** *Rosc.* Zingiberaceae
English: *Ginger;* Kannada: *Shunti.*

18. **Curcuma longa** *L.* Zingiberaceae
English: *Turmeric;* Kannada: *Harisina.*

19. **Manihot esculenta** *Crantz* Euphorbiaceae

English: *Cassava;* Kannada: *Maragenasu.*

20. **Ruta graveolens** *L.* Rutaceae

English: *Rue.*

Many other economic plants of short duration are also grown.

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BOTANICAL MUSEUM LEAFLETS
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NEW ORCHIDS FROM AFRICA

BY

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THIS PAPER contains descriptions of two new genera of Angraecoid orchids and new species belonging to various other genera of African orchids. The type specimens are in the Kew Herbarium unless stated otherwise.

Habenaria (§ **Multipartitae**) **falciloba** *Summerhayes sp. nov.* inter omnes species sectionis labelli lobis lateralibus integris falcatim incurvatis, brachiis stigmaticis e basi liberis facile distinguitur.

Herba verisimiliter terrestris, circiter 1 m. alta, fere omnino glabra; tubera non visa. *Caulis* erectus, robustus, inferne circiter 1 cm. diametro, fere teres, basi radices numerosas flexuosas 1–2 mm. diametro emittens, inferne cataphyllis paucis vaginantibus apice obtusis superioribus foliaceis instructus, superne circiter 9-foliatus. *Folia* erecto-patentia vel suberecta, late lanceolata, apice ± acuminata, usque ad 20 cm. longa et 6 cm. lata, sursum decrescentia in bracteas abeuntia, tenuiter coriacea vel subcarnosa. *Racemus* rectus, circiter 25 cm. longus et 8 cm. diametro, subdense circiter 35-florus; rhachis teres, 3–4 mm. diametro; bracteae foliaceae, anguste lanceolatae, acuminatae, subtus leviter carinatae, usque ad 5 cm. longae et 1.5 mm. latae, inferiores flores aequantes. *Flores* adscendentes; pedicellus cum ovario

2–2.5 cm. longus. *Sepalum* intermedium erectum, convexum, oblongo-lanceolatum, apice acutum, circiter 2.75 cm. longum et 8 mm. latum, dorso carinatum, 5-nervium; sepala lateralia erecto-patentia, oblique lateque lanceolata, leviter curvata, apice acuta, circiter 2.75 cm. longa et 1 cm. lata, 5–6-nervia, dorso carinata. *Petala* cum sepalo intermedio agglutinata, falcata, e basi angusta late lanceolato-cultrata, 2.5 cm. longa, supra medium 7 mm. lata, nervis superne ± divergentibus reticulatis. *Labellum* horizontaliter porrectum, ex ungue 6–7 mm. longo dilatatum, tripartitum, in toto circiter 3 cm. longum et 1.5 cm. latum; partitio intermedia ± inflexa vel incurvata, linearis, apice obtusa, 16 mm. longa, 2 mm. lata, subcarnosa; partitiones laterales incurvatim falcatae, integrae, quam intermedia duplo latiores, apice acutae, 1.25–1.5 cm. longae, inferne 3.75–4 mm. latae, plurinerviae; calcar infra labellum porrectum, leviter recurvatum, dimidio apicali clavato-inflatum, 2 cm. longum, superne 3.5 mm. diametro. *Anthera* 7 mm. alta, hippocrepimorpha; connectivus 5 mm. latus, medio 5.5 mm. altus; loculi fere horizontales vel leviter reclinati, 3.5 mm. longi; canales ± erecti, graciles, 4 mm. longi; staminodia oblonga, parva, sessilia. *Brachia* stigmatifera basi libera, crasse cylindrica, apice truncatim capitata, 9 mm. longa, inferne pubescentia; rostelli lobus intermedius triangulari-lanceolatus, acutus, 1.5 mm. longus, lobi laterales cum anthera adnati, 1 cm. longi.

Belgian Congo: Lualaba District, Kando, 60 miles W. of Jadotville, March 23rd–April 4th 1931, *De Witte 195* (Type in Herb. Brussels).

I have placed the species described above in sect. *Multipartitae*, since it agrees with this section in the general habit, the large flowers, the veining of the sepals, the character of the petals and the long slender anther canals, as well as in the broad horseshoe-shaped anther connec-

tive. On the other hand, the side lobes of the lip are quite entire and in this respect differ from all other species of the section. Furthermore, the stigmas, instead of being adnate to the lower side of the rostellar arms, are quite free from the base and in general structure resemble these organs in other sections of the genus. The anther connective, though very broad, is comparatively tall, agreeing in this feature with *H. egregia* Summerh., but the loculi are almost horizontal in position.

It is evident that in *E. falciloba* we have a very aberrant species which may eventually have to be placed in a distinct section of the genus.

Habenaria (§ **Diphyllae**) **Keayi** *Summerhayes sp. nov.* affinis *H. pilosae* Schltr., a qua statura majore, folio majore ovato vel late ovato apice acutiore, inflorescentia 13–30-flora, petali partitione postica prope basin dente instructa, labelli calcari breviore ± recurvato, anthera distincte apiculata, staminodiis majoribus, brachiis stigmatiferis lateraliter compressis satis distincta.

Herba terrestris, 40–50 cm. alta; tubera ellipsoidea vel cylindrico-ellipsoidea, 1.5–4 cm. longa, 5–15 mm. diametro, breviter tomentosa; radices flexuosae, 1.5–2 mm. diametro, tomentosae. *Folium* singulum vel rarius unum multo minus additum, basale, humistratum, ovatum, vel late ovatum, leviter angulatum, apice acutum, basi cordatum ± amplexicaule, 8.5–9.5 cm. longum, 6.5–11 cm. latum, supra pilis longiusculis albis sparse indutum, subtus glabrum, marginibus dense ciliatis, pallide viride fusco-viridi-lineatum. *Scapus* erectus, teres, basi usque ad 4 mm. diametro, cataphyllis numerosis lanceolatis vel lineari-lanceolatis acuminatis ± adpressis infirma rarius foliacea lanceolata usque ad 3 cm. longa instructus, pilis debilibus albidis ± dense indutus; racemus 12–19 cm. longus, 3–4 cm. diametro, laxiuscule 13–30-florus:

bracteae lanceolatae, acuminatae, pilosae, ovario pedicellato breviores. *Flores* erecto-patentes, pallide virides; pedicellus cum ovario 10–12 mm. longus, dense pilosus. *Sepalum* intermedium erectum, elliptico-ovatum, apice obtusum vel fere rotundatum, circiter 7 mm. longum et 4 mm. latum, valde convexum; sepala lateralia deflexa, oblique et leviter curvatim oblongo-lanceolata, apice subrotundata, 7.5–8 mm. longa, circiter 3.25 mm. lata; omnia sepala trinervia, dorso leviter carinata et pilis patentibus longiusculis instructa. *Petala* fere ad basin bipartita, glabra; partitio postica erecta, falcatim ligulata, sepalo intermedio aequilonga, circiter 1.5 mm. lata, margine postico prope basin dente triangulari vel lineari instructa; partitio antica incurvatim vel falcatim adscendens, circiter 1 cm. longa, basi circiter 0.75 mm. lata, sursum sensim angustata, superne subcarnosa. *Labellum* profunde tripartitum; pars basalis indivisa, 1 mm. longa et 1.5 mm. lata; partitio intermedia fere recta, linearis-ligulata, apice obtusa, marginibus valde recurvatis, carnosa, 9–10 mm. longa, vix 1 mm. lata; partitiones laterales dimidio inferiore patentes, superne recurvatim adscendentes vel circinatae, subcarnosae, circiter 13 mm. longae, inferne 0.7 mm. latae, superne sensim angustatae; calcar leviter recurvatim sigmoideum, dimidio apicali clavatim inflatum, 13–14 mm. longum, 1–1.5 mm. diametro. *Anthera* erecta, 3–5.5 mm. alta, apice distincte apiculata; canales porrecti, circiter 1.5 mm. longi; staminodia breviter stipitata, oblongo-elliptica, circiter 1 mm. longa. *Brachia* stigmatifera antherae canalibus breviora, carnosa, flabellatim capitata, ± lateraliter compressa; rostelli lobus intermedius erectus, magnus, antherae antipositus et eam aequans, elongato-triangularis, acutus, antice excavatus.

Nigeria: Oyo Province, Ibadan Fuel Plantation, Sept. 1949, *Keay* Forest Herb. 25395 (Type).

This interesting species is clearly closely related to the more southern *H. pilosa* Schltr. which occurs in Northern Rhodesia, the Katanga Province of the Belgian Congo and the southernmost part of Tanganyika Territory. It is, however, a taller plant with larger differently shaped leaves, while there are a number of less obvious differences which are mentioned in the diagnosis. The nearest relative in West Africa is *H. Lecardii* Kraenzl., but this has a very much longer spur. The present species was described from dried and spirit specimens.

Vanilla polylepis *Summerhayes sp. nov.* a *V. imperiali* Kraenzl. foliis minoribus, bracteis vix 1 cm. longis, floribus minoribus, labelli disco squamis ± retrorsis fimbriatis instructo satis distinguenda.

Herba alte scandens vel repens, succulenta, foliosa, glaberrima; caules flexuosi, carnosi, usque ad 6 m. longi vel ultra, usque ad 2 cm. diametro, ramosi, laxe foliati, ± longitudinaliter plurisulcati, e nodis radicantes. *Folia* oblanceolata, elliptico-lanceolata vel oblongo-lanceolata, rarius elliptica vel oblongo-elliptica, saepius ± curvata, basi ± rotundata, conduplicata et breviter petiolata vel subsessilia, apice acutata vel leviter acuminata, 6–21 cm. longa, 2.5–8 cm. lata; petiolus usque ad 5 mm. longus. *Inflorescentiae* simpliciter racemosae, ramos laterales terminantes, usque ad 7 cm. longae, dense usque ad 25–30-florae; rhachis carnosa, circiter 1 cm. diametro; bracteae ovato-triangulares, acutae, subpatentes, 6–7 mm. longae. *Flores* pallide virides vel viridi-albi; pedicelli cum ovariis 4–6 cm. longi. *Sepalum* intermedium oblanceolatum, acutum, 3.5–5.25 cm. longum, 8.5–9.5 mm. latum, 9–11-nervium; sepala lateralia leviter oblique oblanceolata, intermedio aequilonga, 9–12.5 mm. lata, 10–12-nervia; omnia sepala nervis juxta apicem convergentibus. *Petala* leviter oblique oblanceolata, acuta,

3.75–5.5 cm. longa, 10–14 mm. lata, 11–13-nervia, nervis juxta apicem vix convergentibus tribus centralibus approximatis, dorso carina humili e basi per 2.5–4.5 cm. longa in apiculo acuto terminante instructa. *Labellum* e basi angustissima superne sensim sed valde dilatatum, obovato-flabellatum, antice ± obtuse incisum, 4.5–5.5 cm. longum, superne explanatum 3–3.5 cm. latum, cum columna per 2–2.75 cm. connatum, basi tubum angustum superne dilatatum formans, antice marginibus valde undulatis, multinervium; discus medio secus nervos tres medianos squamis numerosis retrorsis instructus; squamae anticae lineares, integrae, denticulatae vel dentatae, intermediae transversae, ovatae vel oblongae, valde pectinatae vel pectinato-incisae, posticae breviores, minus pectinatae, postremae minutae papillis similes. *Columna* fere recta, 2.75–4.25 cm. longa, semiteres, apice leviter incurvata utrinque ala recurvatim oblongo-ovata obtusa instructa; anthera quadrata antice angustata; medio longitudinaliter sulcata; rostellum deflexum, ovato-triangulare, circiter 2 mm. longum. *Fructus* immaturus carnosus, cylindricus, sursum angustatus, bisulcatus, 11–12 cm. longus, inferne 1.5 cm. diametro.

Angola: Moxico District, island in river just above Lusavo Falls, in evergreen vegetation, on ground and climbing up trees, Jan. 21st 1938, *Milne-Redhead 4265*.

Northern Rhodesia: Mwinilunga District, River Matonchi, above dam, in evergreen fringing forest, climbing up tree trunks and trailing on the ground, Oct. 23rd–24th 1937, *Milne-Redhead 2930* (Type). "Stem and leaves deep green; one flower only out at time in any inflorescence; sepals and petals greenish white; lip in front white, in throat sulphur-yellow; column whitish; very faint mauve lines just in front on channel inside lip; flowers when fading scented of vanilla." Mkusi District, Chiwefwe, 60 miles E.N.E. of Kapiri Mposhi, 1200 m. alt., probably from evergreen fringing bush, Nov. 1934, *Trapnell 1653*. "A very tall succulent liane; flowers greenish." Abercorn District, Upper Lunzula River falls, 1650 m. alt., in evergreen riverain forest, locally common, May 28th 1936, *Burtt 6338* "A dark green succulent climber ascending to 6 m."

Belgian Congo: Katanga District, Elisabethville, 1440 m. alt., Nov. 22nd 1911, *Rogers 10148*. Same locality, in thick woods near water, Sept. 1923, *Von Hirschberg 28*. "Sepals and petals pale green; lip snowy white shaded with orange to pale yellow, two mauve lines from base to edge."

This is apparently not an uncommon plant in the fringing forests along the rivers and streams in a wide area from eastern Angola to the Abercorn district of Northern Rhodesia. As in its nearest ally, *V. imperialis* Kraenzl., the lip and column, which are united nearly to the top of the latter, form a trumpet-shaped tube which is very narrow at the base and widens gradually upwards. The sides of the lip are folded over the apex of the column, but the lip is not distinctly lobed though there may be a sinus of varying depth in the centre of the apex. The scales forming the central crest are very variable in character, the front ones being long and narrow, entire or more or less toothed, and resembling those forming the crest of *V. imperialis*. The central ones, however, are broad and transversely placed, usually long-pectinate or incised all around, but showing some approach to the simpler scales in *V. africana* Lindl., *V. ramosa* Rolfe and similar species. Farther back the scales are shorter but still pectinate or with long irregular teeth, while in the lower part the outgrowths consist entirely of short papillae-like hairs. The specific epithet is given in allusion to this assemblage of scale-like outgrowths.

Malaxis (§ **Katochilos**) **katangensis** *Summerhayes sp. nov.* affinis *M. pygmaeae* Summerh., a qua statura majore, foliis plus duplo majoribus, sepalis uninerviis, labello ambitu quadrato basi angustato distinguenda.

Herba terrestris, 9–12 cm. alta; tubera ellipsoidea, circiter 1 cm. longa et 5 mm. diametro. *Caulis* brevis,

erectus, 1–2 cm. altus, basi radices flexuosas graciles tomentosas emittens, superne cataphyllis paucis laxe vaginantibus apice ± recurvatis acutis omnino vestitus, apice 2–3-foliatus. *Folia* patentia vel leviter recurvata, fere humistrata, sessilia, late ovata vel elliptico-ovata, basi caulem amplectentia, apice subacuta vel obtusa, 2.5–5 cm. longa, 1.75–3 cm. lata, siccitate textura tenuiter papyracea, plurinervia. *Inflorescentia* erecta, 8–10 cm. longa, superne subdense multiflora; pedunculus 5–6 cm. longus, gracilis, inferne fere teres, superne pluri-angulatus et angustissime alatus, cataphyllis 3–5 dissitis lanceolatis acuminatis 3–4 mm. longis instructus; rhachis pluriangulata; bracteae adpressae, lanceolato-ovatae, valde acuminatae, 2.5–3.5 mm. longae, 1.5–2.25 mm. latae, uninerviae. *Flores* pro sectione parvi, rhachidi ± adpressi, virides, ± hyalini; pedicellus cum ovario 2–2.5 mm. longus. *Sepalum* intermedium erectum, elliptico-lanceolatum, basi ± rotundatum, apice subacutum vel obtusum, 2–2.5 mm. longum, 1–1.25 mm. latum; sepala lateralia libera, incurvatim deflexa, oblique ovato-lanceolata, apice fere acuta, 1.75–2.25 mm. longa, 1.2–1.5 mm. lata. *Petala* patentia, leviter recurvata, lanceolato-ligulata, apice obtusa, inferne leviter ampliata, 1.75–2.25 mm. longa, 0.3–0.6 mm. lata, marginibus integris vel brevissime papilloso-ciliolatis; omnia tepala uninervia. *Labellum* inferum, sessile, ambitu ± quadratum, antice rotundatum leviter emarginatum, basin versus sensim angustatum, basi auriculis semiovatis 0.25–0.45 mm. longis columnam amplectentibus instructum, in toto (auriculis inclusis) 1.75–2.25 mm. longum, 1.6–1.75 mm. latum, 5-nervium, basi tuberculis duobus humilibus, medio pulvino dense puberulento quadrato instructum. *Columna* incurvata, 0.7 mm. longa; anthera hemisphaerica; rostellum truncatum.

Belgian Congo: Katanga Province, Noots Farm, near Elisabeth-

ville, close to roots of large shady trees, very abundant, December 9th 1923, *C. W. von Hirschberg 152* (Type); Kisenga Valley, groups of 20–100 plants growing at foot of large trees, Dec. 27th 1924, *Von Hirschberg 152* (Herb. Bruxell.); Kantu, by water, Jan. 26th 1908, *Kassner 2401*.

This species is very similar to *M. pygmaea* Summerh. in floral structure and general growth, but is a much larger plant with larger leaves and minor differences in the flower structure as indicated in the diagnosis. From most other species of section *Katochilos*, it may be distinguished by the very short stem, the leaves thus appearing almost on the ground. It appears to be decidedly local in occurrence, though it may be very abundant where it does occur.

Malaxis (§ **Katochilos**) **pygmaea** *Summerhayes sp. nov.* inter species sectionis statura nana, cauli brevissimo, foliis et floribus parvis, labelli basi bituberculata facile distinguenda.

Herba terrestris, pusilla, usque ad 5 cm. alta; tubera 1–3, ovoidea vel ellipsoidea, 6–10 mm. longa, 3–5 mm. diametro, alba, cataphyllorum cicatricibus annulatis notata; caulis erectus, 1–1.5 cm. longus, 1.5–2 mm. diametro, maxima pro parte subterraneus, cataphyllis pluribus ± omnino vestitus, apice 2–3-foliatus. *Folia* patentia, fere humistrata, sessilia, late ovata vel elliptico-ovata, basi caulem amplectentia, apice acuta apiculato-acuminata, 7–20 mm. longa, 6–17 mm. lata, plicata, plurinervia. *Inflorescentia* erecta, leviter flexuosa vel curvata, 1–4 cm. longa, superne dense multiflora; pedunculus usque ad 2 cm. longus, teres vel obscure angulatus, gracilis, cataphyllis paucis late lanceolatis caudato-acuminatis usque ad 3.5 mm. longis instructus; rhachis angulata; bracteae ± adpressae, lanceolato-ovatae, longe acuminatae, usque ad 2.5 mm. longae, uninerviae. *Flores* pro sectione parvi, suberecti, rhachidi ± adpressi, flavo-virides;

pedicellus cum ovario circiter 2 mm. longus. *Sepalum* intermedium erectum, ovato-oblongum, basi ± rotundatum, apice obtusum vel subrotundatum, 1.75–2 mm. longum, circiter 1 mm. latum, 2–3-nervium; sepala lateralia deflexa, incurvatim oblique ovata, apice subrotundata, 1.25–1.5 mm. longa, vix 1 mm. lata, 2- vel subtrinervia. *Petala* patentia vel ± recurvata, leviter oblique anguste ligulata, apice obtusa, 1.25–1.5 mm. longa, circiter 0.3 mm. lata, marginibus apice et basi exceptis papillato-ciliolatis, uninervia. *Labellum* inferum (vel anticum), sessile, ambitu ellipticum vel elliptico-quadratum, basi in auriculas rotundatas columnam ± amplectentes decurrens, in toto (auriculis inclusis) circiter 1.75 mm. longum, medio circiter 1.5 mm. latum, marginibus undulatis, apice rotundatum leviter emarginatum, 5-nervium, basi tuberculis vel callis humilibus orbicularibus medio pulvino puberulento trapeziformi instructum. *Columna* brevis, porrecta, subteres, apice truncata, circiter 0.35 mm. alta; anthera hemisphaerica; fovea stigmatica elliptica; rostellum truncatum.

Northern Rhodesia: Mwinilunga District, just north of Mwinilunga on shallow soil overlying laterite in *Brachystegia-Isoberlinia* woodland, Jan. 26th 1938, *Milne-Redhead 4359* (Type) "Tubers white, ringed; leaves green, plicate; flowers yellow-green."

The species is described from over 25 specimens dried or in liquid preservative. *M. pygmaea*, as the name suggests, is the smallest species of the genus found so far in Africa, reaching at the maximum a height of 5 cm. and being usually much smaller. Another striking feature is the very short stem, most of which is below the surface of the ground, the leaves consequently being practically at ground level.

The species in general floral structure belongs clearly to the section *Katochilos* Schltr. in which the lip is anterior in position. This section includes six other species in Tropical Africa and one in Madagascar.

Malaxis Hirschbergii *Summerhayes sp. nov.* affinis *M. Maclaudii* (Finet) Summerh., a qua floribus majoribus, labelli marginibus basalibus incrassatis valde prominentibus, labelli dimidio antico subito dilatato satis distincta.

Herba terrestris, 10–15 cm. (fide collectoris 25 cm.) alta, glaberrima; tubera non visa. *Caulis* erectus, circiter 5 cm. altus vel ultra, basi radices graciles flexuosas emittens, superne cataphyllis 3–4 inferne vaginantibus apice subfoliaceis liberis acutis vestitus, apice 2–3-foliatus. *Folia* ± patentia, 1–2 cm. petiolata, lanceolata vel elliptico-lanceolata, apice acuta, in toto 3–7 cm. longa, 1.5–3.3 cm. lata, siccitate molliter papyracea, 5-nervia. *Inflorescentia* erecta, circiter 7–8 cm. longa, apice dense multiflora; pedunculus 5–7 cm. longus, basi fere teres, superne anguste bialatus, cataphyllis circiter 3 dissitis lanceolatis valde vel caudato-acuminatis 6–8 mm. longis instructus; rhachis brevis, fere 1 cm. longa; bracteae lanceolatae, acuminatae, usque ad 6 mm. longae, ovario pedicellato breviores. *Flores* erecto-patentes, pseudo-umbellati, pallide rubro-purpurei; pedicellus cum ovario usque ad 13 mm. longus. *Sepalum* intermedium oblongo-lanceolatum, acutum, 5.5–5.75 mm. longum, 2–2.5 mm. latum; sepala lateralia libera, oblique lanceolato-oblonga, subacuta, 5 mm. longa, 2–2.4 mm. lata. *Petala* elliptico-lanceolata, apice acuta, 4.5–4.8 mm. longa, 1.75–2.25 mm. lata, marginibus ciliolatis; omnia tepala trinervia. *Labellum* inferum, sessile, ambitu late flabellatum, dimidio basali marginibus incrassatis, in toto 4–4.5 mm. longum, antice 4.7–4.9 mm. latum, dimidio apicali subito dilatatum, transverse ellipticum, marginibus breviter laceratis, basi callis duobus ligulatis humilibus parallelis antice sensim dilatatis, callo dentiformi porrecto vel recurvato anteposito instructum, medio nervis tribus parallelis utrinque nervo arcuato apice convergenti extus

ramoso instructum. *Columna* leviter incurvata, 1.5–1.75 mm. longa, semiteres; anthera semiellipsoidea, 0.5–0.6 mm. longa; rostellum ligulatum, anguste truncatum.

Belgian Congo: Katanga Province, Kinsenga River, near Elisabethville, in wet dark places at river's edge under trees, only found in this locality, Nov. 30th 1923, *C. W. von Hirschberg 111* (Type; Isotype in Herb. Brussels).

This is clearly an ally of *M. Maclaudii* (Finet) Summerh. and *M. Chevalieri* Summerh., both of which are found in the general region stretching from French Guinea to the Sudan along the north side of the Equatorial Forest belt. These are all characterised by the very short apparently umbellate raceme, the relatively broad fan-shaped lip and the tepals all more or less similar to one another. The present species may be distinguished most readily by the great development of the thickened margin of the lower part of the lip which in this species extends for half the total length; above this thickened margin the lip suddenly widens to form a thin transversely elliptical portion which is shortly lacerate all round. In *M. Maclaudii* the basal thickened portion is very poorly developed, while *M. Chevalieri* lacks the central projecting tooth-like callus.

Liparis odontochilos *Summerhayes sp. nov.* affinis *L. Deistelii* Schltr., sed labello medio subito dilatato marginibus lateralibus grosse dentatis differt.

Herba terrestris vel epiphytica, usque ad 13 cm. alta. *Caulis* primarius repens, gracilis, teres, 1–2 mm. diametro, cataphyllis arcte vaginantibus obtusis ± obtectus, radices flexuosas hic illic emittens; caulis secundarius erectus, basi valde incrassatus, carnosus, pseudobulbum anguste conicum formans, sursum sensim angustatus, inferne cataphyllis subfoliaceis acutis vestitus, superne 3–4-foliatus, usque ad 5 cm. altus. *Folia* lanceolata vel

elliptico-lanceolata, acuta, basi in vaginam angustata sed vix petiolata, usque ad 8 cm. longa et 2.5 cm. lata, plicata, textura tenuia, marginibus leviter undulatis. *Inflorescentia* recta vel leviter curvata, usque ad 8 cm. longa, superne sublaxe 2–10-flora; pedunculus teres, angustissime alatus, 2–5 cm. longus, cataphyllis paucis lanceolatis acutis instructus vel nudus; rhachis angulata vel anguste alata; bracteae erecto-patentes, lanceolatae, acutae, usque ad 8 mm. longae. *Flores* erecto-patentes, virides vel purpureo-striati vel purpureo-tincti; pedicellus cum ovario circiter 8 mm. longus, gracilis. *Sepalum* intermedium recurvatum, lanceolato-ligulatum, apice acutum, basi auriculatum ± amplexicaule, 4.5–8.75 mm. longum, medio 1.25–2 mm. latum; sepala lateralia primo fere ad apicem connata, synsepalum orbiculari-obovatum, apice rotundatum, totum 3.5–6.25 mm. longum, 3.25–6.4 mm. latum formantia, demum ± libera; omnia sepala trinervia. *Petala* deflexa, linearia, apice obtusa, basi cum sepalis adnata dilatata, 5–10 mm. longa, 0.35–1 mm. lata, uni- vel subbinervia. *Labellum* e basi angusta breviter auriculata subito dilatatum, subflabellatim transverse oblongum, antice truncatum, late emarginatum cum apiculo interjecto, marginibus lateralibus grosse dentatis, 3–6.5 mm. longum, 4–7.5 mm. latum, basi callo transverso obtuse bidentato instructum. *Columna* incurvata, semiteres, apice dilatata, late alata, 2.3–5 mm. longa; anthera cucullata, antice emarginata.

Belgian Congo: Ruwenzori, Lanuri, 1700–1800 m. alt., on a rotten trunk in the shade, June 1st 1914, *Bequaert 4629*.

Uganda: Kigezi, impenetrable forest, creeping in moss on shady bank in forest, Nov. 1948, *Eggeling 5851*.

Kenya Colony: East Aberdare Mountains, *Ocotea* forest, in moss on tree-fern stems, *Dale 1860* (Type); same locality, Thiririki River, Nov. 1937, *Cunningham-van Someren 21*.

Tanganyika Territory: Lossogonoi, S. by W. of Moshi, summit of mountain, 2090 m. alt., in leaf mould on rocky ledge, coll. H.F.I. Elliott, cult. and flowered Amani, May 20th 1944, *Moreau 770*.

This small creeping species is clearly related to *L. Deistelii* Schltr. which also occurs in East Africa. It may be distinguished by the lip being suddenly broadened in the front part with the outer margins very coarsely toothed. The basal callus is more clearly transverse, with two lateral rounded knob-like teeth.

Bulbophyllum encephalodes *Summerhayes sp. nov.* affine *B. oreonasti* Rchb.f. et *B. unifoliato* De Wildem., ab illo pseudobulbis unifoliatis, pedunculo quam rhachide duplo longiore, ab hoc pseudobulbis quadrangularibus, foliis latioribus, floribus majoribus ± atrorubris nec flavis, ab utroque labelli dimidio apicali rimis complicatis sinuosis verrucisque ita instructo ut cerebrum simulet satis differt.

Herba epiphytica, glaberrima. *Rhizoma* repens, usque ad 35 cm. longum, 2–3.5 mm. diametro, primo vaginis scariosis 5–7 mm. longis, 5–12 mm. distantibus instructum, sub pseudobulbis radices caespitosas flexuosas ramosas tenues griseas emittens. *Pseudobulbi* 1.5–8 (saepius 4–6) cm. distantes, elliptico-oblongi vel conico-elliptici, ± compressi, acute tetragoni, apice ± truncati, monophylli. *Folia* oblonga, elliptico-oblonga vel elliptica, basi conduplicata, in petiolum brevissimum angustata, apice rotundata, 3–12 cm. longa, 1.2–3.2 cm. lata, subcarnosa, coriacea, supra leviter canaliculata. *Scapus* erectus, racemo ± recurvato vel dependente, 13–26 cm. altus; pedunculus rectus vel ± leviter curvatus, teres, 11–24 cm. longus, 1–2 mm. diametro, vaginis 4–7 arctissimis, obtusis, distantibus, 5 -13 mm. longis instructus; rhachis valde compressa, 2–7 cm. longa, 3 mm. lata, marginibus leviter sinuatis, dense multiflora. *Flores* distichi, e rhachidis marginibus alternatim exorientes, sessiles, rubro-virides vel ± atrorubri; bracteae patentes vel leviter recurvatae, rigidae, ovatae vel lanceolato-ovatae, acuminatae, 2.5–5

mm. longae, scariosae. *Sepalum* intermedium lanceolato-ovatum, acuminatum, 4–5 mm. longum, 2.5–3.25 mm. latum, valde convexum, ± incurvatum; sepala lateralia oblique lanceolato-ovata, longiuscule subulato-acuminata, 4.5–5.25 mm. longa, basi 2.25–3 mm. lata, mento brevi 0.75–1 mm. longo; omnia sepala trinervia. *Petala* lanceolato- vel elliptico-oblonga, acuta, 2.5–3 mm. longa, 0.6–1 mm. lata, uninervia. *Labellum* valde carnosum, ambitu ovoideo-ellipsoideum, leviter curvatum, totum 2.5–3 mm. longum, 1.5–1.75 mm. latum, inferne carinis humilibus ± parallelis, medio praesertim subtus rimis complicatis sinuosis reticulatis ± transversis, apice verrucis numerosis irregularibus instructum. *Columna* brevis, semi-teres, 2 mm. alta, stelidiis brevibus acutis, androclinio leviter excavato; anthera ± hemisphaerica, leviter retusa; ovarium crassum, 2–3 mm. longum, teres, leviter plurisulcatum. *Capsulae* ellipsoideae, 7 mm. longae, 4–5 mm. diametro.

Uganda: Ankole, Kalinzu Forest, Aug. 1936, *Eggeling 3196;* "Epiphyte, flowers greenish with purple spots and claret centre."

Kenya Colony: Kericho District, Dec. 1933, *Gray 3;* Kakamega Forest, 1500 m. alt., bank of river in bush country, Oct. 1939, *Tweedie 492;* "Epiphyte, flowers plum-coloured with darker streaks."

Tanganyika Territory: East Usambara Mts., Bomole, near Amani, 1050 m. alt., growing on quinine and other trees in comparatively dry situations, Nov. 29th 1940, *Moreau 6* (Type); "Tepals mainly green, edged with maroon, upper side of labellum dark maroon." Between Amani and Monga, 900 m. alt., epiphytic in topmost branches of evergreen rain-forest of *Cephalosphaera*, *Tylostemon kuao* and *Parinari holstii*, Nov. 18th 1936, *Greenway 4742;* "Flowers greenish crimson."

Belgian Congo: Katanga, near Elisabethville, on trees near stream, July 31st 1930, *Hutchinson 4122;* "Flowers deep crimson." Lubunbashi, epiphytic in gallery forest, Nov. 1927, *Quarré 908;* Katanga, no locality, epiphyte in forest plantation, Feb. 1935, *Quarré 4454.*

Northern Rhodesia: Mwinilunga District, River Mwanamitawa, about 12 miles west of River Lunga, epiphytic on tree trunk in *Cryptosepalum* woodland, Aug. 22nd 1930, *Milne-Redhead 945;* "Flowers reddish-purple, lip dark purplish-black, column pinkish, anther white." Same district, slope east of River Matonchi and by river, on trees in

Brachystegia woodland and also in evergreen vegetation, flowered May 16th 1938, *Milne-Redhead 4375;* "Sepals green, mottled maroon, petals greenish-yellow, edged maroon, lip white, side lobes maroon, anther lemon-yellow."

This is clearly a widely spread species, mainly in savanna vegetation but also in rain-forest. Its affinities and characteristic features are set out in the diagnosis. The frequently more or less reflexed or almost pendulous raceme is an interesting character. The lip is a truly remarkable structure which is very difficult to describe. It is very fleshy, more or less ellipsoidal, and somewhat curved especially in the lower part. Here there are two low parallel keels which run forward for about two-thirds of the lip becoming lower and more undulate or sinuous towards their apices. The body of the lip is smooth at the base, but in the centre the surface becomes increasingly broken up by very curved sinuous fissures forming a coarse and irregular reticulation. In the apical third this fissuring becomes so pronounced as to produce a series of large irregular warts covering the whole surface. The general effect is reminiscent of a brain, hence the specific epithet. These irregularities are well shown in several gatherings in liquid preservative and are not due to drying.

Bulbophyllum porphyrostachys *Summerhayes sp. nov.* affine *B. lupulino* Lindl. a quo rhachide medio anguste nuda, bracteis purpureis apice breviter incurvatis, labello magis carnoso alis angustissimis apice verrucoso facile distinguendum.

Herba epiphytica, glabra; rhizoma repens, teres, 2–3 mm. diametro, basi pseudobulborum radices numerosas flexuosas ramosas emittens. *Pseudobulbi* 2.5–4 cm. distantes, erecti, saepius 4-angulati, ellipsoidei vel oblongo-ellipsoidei, 2–4 cm. longi, 1.5–2 cm. diametro, basi cataphyllis paucis, scariosis apiculatis ± vestiti, apice diphylli.

Folia erecto-patentia, e petiolo brevi ligulata vel oblanceolato-ligulata, apice rotundata vel apiculata, 8–13 cm. longa, supra medium 1.3–2.3 cm. lata, saturate viridia, supra nitentia, secus medium leviter canaliculata, subtus leviter carinata. *Scapus* e basi pseudobulbi ortus, rectus vel leviter curvatus, folia aequans vel brevior, usque ad 15 cm. altus; pedunculus 4–6 cm. longus, teres, viridis, cataphyllis 5–8, laxe ochreatis, acutis, 7–10 mm. longis fere omnino vestitus; rhachis anceps, leviter fractiflexa, 5–10 cm. longa, 2.5–3 mm. lata, viridis; bracteae distichae, patentes, imbricatae, ovato-cymbiformes sed valde lateraliter compressae, apice leviter incurvatae, 9–13 mm. longae, 5–6 mm. latae, fusco-purpureae, glabrae. *Flores* sessiles, quam bracteae multo breviores, purpurei vel virides purpureo-maculati, semiclausi. *Sepalum* intermedium incurvatum, valde concavum, triangulari-ovatum, apice acutum, apiculatum leviter cucullatum, circiter 4 mm. longum, 1.8–2 mm. latum; sepala lateralia oblique ovata, apice falcatim decurvata, acuminata, fere 4 mm. longa, circiter 2.5 mm. lata; omnia sepala subcarnosa, viridia, intus purpureo-notata. *Petala* linearia, leviter falcatim curvata, apice obtusa vel subacuta, 2.3 mm. longa, 0.3 mm. lata, viridia vel purpurea. *Labellum* valde carnosum, sectione semiteres, ambitu ellipticum, supra leviter excavatum, medio canaliculatum, subtus valde convexum, utrinque ala angustissima denticulata instructum, apice verrucosum, circiter 2 mm. longum, 1.6–1.7 mm. latum, saturate purpureum. *Columna* semiteres, 2.3 mm. alta, superne anguste alata, stelidiis ovatis acutis antheram aequantibus; anthera cucullata, ambitu elliptica, antice breviter producta; fovea stigmatica quadrata, antice labio prominente instructa; ovarium crassum, vix angulatum, deorsum angustatum, 2 mm. longum.

NIGERIA: Benin Prov., Okomu Forest Reserve, near Nikrowa, in high forest on crown branches of fallen *Corynanthe*, Dec. 1947, cult.

and flowered Ibadan, Oct. 1948, *Keay in Forest Herbarium 22711* (Type); Benin Prov., Sapoba Forest Reserve, in broken high forest, on crown branches of large *Irvingia gabunensis*, Oct. 28th 1946, *Keay & Onochie in Forest Herbarium 21590.*

This very striking species is clearly closely related to *B. lupulinum* Lindl., possessing similar large spreading imbricating bracts and a very similar flower structure. It may, however, be easily distinguished by the different shape of the quite glabrous purple or crimson bracts, which here have a slightly incurved apex and consequently a slight dip in the upper margin. In *B. lupulinum* the upper margin is either almost straight or evenly convex all along, while the bracts are fawn coloured and dotted all over with small furfuraceous hairs. In our species the bases of insertion of the two rows of bracts are separated so that there is a narrow median strip of the rhachis visible nearly to the apex, whereas in *B. lupulinum* the bases of the bracts often overlap in a vertical direction so that the rhachis is only visible on elongation. The lip in *B. porphyrostachys* is extremely fleshy with a rounded convex lower surface and a flat or slightly convex upper surface. At the edge of this are the very narrow toothed wings which are a little wider in front. The apex of the lip is furnished with a number of small warty excrescences.

Triceratorhynchus *Summerhayes gen. nov.*

Epiphytica. *Caulis* brevissimus, plurifoliatus. *Folia* linearia, apice vix bilobulata. *Inflorescentiae* patentes, elongatae, pluriflorae. *Flores* parvi, pedicellati. *Sepala* et *petala* libera, inter se similia, patentia, anguste lanceolata. *Labellum* calcaratum, simplex, concavum, lanceolatum, ecallosum, tepalis aequilongum; calcar gracile, ex ore angusto cylindricum, labelli laminam superans vel aequans. *Columna* brevis, crassa, apice truncata; androclinium leviter excavatum, dorsum versus reclinatum;

anthera postice hemisphaerica, antice in appendicem triangularem obtusam eroso-ciliatam producta; pollinia 2, ellipsoidea, stipitibus duobus brevibus paulo supra medium viscidiorum exorientibus, viscidiis duobus distinctis elliptico-ligulatis, stipitibus multo longioribus; rostellum utroque productum, viscidiis amotis utroque trifurcatum, sursum lobis lateralibus quam intermedio satis longioribus, deorsum lobis lateralibus triangulari-dentatis lobo intermedio fere subulato longiore; fovea stigmatica quadrata vel fere orbicularis.

Species unica: *T. viridiflorus* Summerh.

This plant, which looks rather like an *Angraecopsis* or small *Angraecum*, is chiefly characterised by the remarkable structure of the rostellum. This is attached to the apex of the column and is produced both upwards and downwards from the point of attachment to form a roughly ovate shield-like plate. On removal of the two elongated viscidia the rostellum is left trifurcate in both directions, the upward prolongations being longer than those downwards. The general effect is to produce a tridentlike or 3-horned structure in both directions. The two vertical erect lateral lobes are somewhat incurved and nearly twice as long as the narrower very acute central lobe; on the other hand, the downwardly produced middle lobe, which is very similar to the upward one, is considerably longer than the quite short lateral lobes.

Another interesting feature is in the anther which is produced in front into a broadly triangular beak which is erose-ciliate all around the front margins.

The genus is perhaps most closely allied to *Sphyrarhynchus* Mansf. which has a short column with the broad rostellum produced both upwards and downwards to form a hammer-head like structure. In the latter genus, however, there is only a single viscidium and on removal of this the rostellum is obtusely bilobed or almost entire.

Both genera are small plants with few-flowered racemes and relatively small leaves, though in *Sphyrarhynchus* these are much broader than in the present genus.

Triceratorhynchus viridiflorus *Summerhayes sp. nov.*

Planta pusilla, epiphytica: caulis brevissimus, circiter 5 mm. longus, 3–5-foliatus, radices numerosas flexuosas emittens. *Folia* suberecta vel ± reflexa, linearia, saepius ± curvata, apice obscure inaequaliter bilobulata vel integra, acuta, lobulo breviore dentiformi, lobulo longiore usque ad 1.5 mm. longo, tota 1–5 cm. longa, 1–3.5 mm. lata, supra ± concava, carnosula. *Inflorescentiae* ex axillis foliorum exortae, patentes vel horizontales, paucivel plurifforae, usque ad 6 cm. longae; pedunculus usque ad 2 cm. longus, gracilis, teres, vaginis paucis acutis brevibus instructus; rhachis pedunculo similis; bracteae breviter ochreatae, late ovatae, acutae, 1–1.5 mm. longae. *Flores* usque ad 9, 4–6 mm. distantes, patentes, virides ad flavi; pedicellus cum ovario 4–5 mm. longus, saepius medio ± geniculatus. *Sepalum* intermedium lineari-lanceolatum, acutum, 4.25–5.5 mm. longum, 0.75–1.25 mm. latum, trinervium; sepala lateralia oblique lanceolato-ligulata, leviter curvata, subacuta, 5.25–6.25 mm. longa, 0.9–1.2 mm. lata, tri- vel subquadrinervia. *Petala* curvatim lineari-lanceolata, acuta, 4.25–5.25 mm. longa, vix 1 mm. lata, trinervia; omnia tepala patentia vel ± recurvata. *Labellum* valde concavum, ambitu late lanceolatum, acutum, medio obscure trilobatum, lobis lateralibus erectis brevissimis rotundatis, lobo intermedio superne incrassato recurvato, totum 4.75–5.5 mm. longum, explanatum circiter 3.5 mm. latum, plurinervium; calcar ex ore angusto cylindricum, leviter incurvatum, apice obtusum, 5.5–8 mm. longum. *Columna* generis, circiter 0.75 mm. longa; anthera circiter 1 mm. longa;

pollinia 0.25–0.5 mm. longa, stipitibus ± geniculatim decurvatis apice subspathulato-dilatatis 0.2 mm. longis, viscidiis ligulatis utroque rotundatis marginibus hyalinis 0.7 mm. longis; rostellum viscidiis amotis sursum trifurcatum, lobis lateralibus leviter convergentibus cornibus similibus circiter 0.5 mm. longis, lobo intermedio triangulari-subulato quam lateralibus satis breviore, deorsum breviter trifurcatum, lobis lateralibus brevibus triangularibus acutis, lobo intermedio fere duplo longiore subulato-lineari, circiter 1.5 mm. longo.

UGANDA: Bunyoro, Budongo Forest, June 1935, *Eggeling 2058;* same locality, epiphytic on *Olea Welwitschii*, cult. and flowered Busingiro, June–July 1944, *Eggeling 5492* (TYPE).

KENYA COLONY: Kakemega Forest, 1500 m. alt., June 1944, E.W. Carroll; comm. *E.M. Tweedie 648.*

This plant is probably generally distributed in the forests of this region, but it is easily overlooked on account of its small size and inconspicuous green flowers.

Eggelingia *Summerhayes gen. nov.*

Epiphytica. *Caulis* monopodialis, elongatus, basi radicans, superne laxe foliatus. *Folia* ligulata, apice bilobulata. *Inflorescentiae* ex axillis foliorum ortae, brevissimae, pauciflorae. *Flores* parvi, pedicellati. *Sepala* libera, ± patentia, lanceolata vel oblonga, aequalia. *Petala* oblonga, quam sepala paulo minora. *Labellum* calcaratum, simplex, ovatum, acutum, ecallosum, sepalis aequilongum; calcar fere rectum, ore pro rata angustum, cylindricum, prope apicem paulo dilatatum, labelli laminae aequilongum. *Columna* brevis, crassa, apice truncata, semiteres; androclinium leviter excavatum; anthera hemisphaerica, antice in appendicem acutam producta; pollinia 2, ovoidea vel subpyriformi-ovoidea, stipite ligulato apice truncato dilatato ± incurvato, viscidio rectangulari-elliptico stipite paulo breviore, rostellum de-

flexim porrectum, triangulare, viscidio amoto profunde bifidum; fovea stigmatica rectangularis.

Species duae, Africae tropicae incolae.

Species typica: *E. ligulifolia* Summerh.

This small genus resembles very closely some species of *Tridactyle* and, in vegetative characters, certain species of *Angraecum*, all having rather long straggling stems with spreading ligulate leaves. The very short inflorescences are also very reminiscent of *Tridactyle* such as *T. anthomaniaca* (Rchb.f.) Summerh. and *T. Scottellii* (Rendle) Schltr., especially those species in which the lip is almost entire. *Eggelingia* differs, however, in the quite entire lip, which lacks the thickened basal auricles so characteristic of *Tridactyle*, and in the very large rectangular viscidium, which is nearly as long as the stipes and longer than the pollinia. The genus is best placed next to *Tridactyle*.

The genus is distributed from the Gold Coast in the west to the forests of western Uganda in East Africa, being widely spread in the forests of the eastern Congo Basin. It is named in honour of Dr. W. J. Eggeling who has done so much towards increasing our knowledge of the epiphytic orchids of Uganda.

Eggelingia ligulifolia *Summerhayes sp. nov.*

Planta epiphytica vel rarius saxicola. *Caules* saepius singuli, pauciramosi, saepius ± penduli vel e basi descendente sursum arcuati, graciles, usque ad 45 cm. longi, 2–3 mm. diametro, basi vel inferne radices griseas flexuosas emittentes, foliorum delapsorum vaginis omnino vestiti, superne laxiuscule foliati. *Folia* circiter 1 cm. distantia; vagina arcta, leviter transverse rugulosa, sicecitate longitudinaliter costulata, internodium aequans vel paulo longior, apice laminae opposita ligula subulata usque ad 7 mm. longa instructa; lamina sessilis, ± patens

vel rarius recurvata, ligulata vel lineari-ligulata, apice inaequaliter bilobulata vel subacuta, lobulo longiore usque ad 6 mm. longo, supra secus medium canaliculata, subcarnosa, 2–7 cm. longa, 5–8 mm. lata. *Inflorescentiae* ex axillis foliorum ortae, brevissimae, 2–3-florae; pedunculus fere nullus; rhachis fractiflexa, usque ad 3 mm. longa; bracteae triangulares, acutae, pedicello cum ovario duplo breviores. *Flores* albi; pedicellus cum ovario 4.75–6.75 mm. longus. *Sepalum* intermedium late lanceolatum, acutum, 5.25–6.75 mm. longum, 2.2–2.6 mm. latum, trinervium; sepala lateralia oblique lanceolata, leviter curvata, acuta, 4.5–7.75 mm. longa, 2–2.3 mm. lata, 2-nervia. *Petala* oblonga vel oblongo-lanceolata, subacuta vel obtusa, leviter obliqua, 4.5–6 mm. longa, 1.75–2.25 mm. lata, subtrinervia. *Labellum* valde concavum, late lanceolatum vel lanceolato-ovatum, apice leviter acuminatum, 4.5–5.75 mm. longum, explanatum 2.75–3.5 mm. latum, plurinervium; calcar fere rectum, cylindricum, vix inflatum, 4–5 mm. longum. *Columna* crassa, 1.25–1.75 mm. longa, structura generis; pollinia 0.6–0.8 mm. longa; stipes 1–1.7 mm. longus; viscidium 1.3–1.4 mm. longum; ovarium leviter 6-sulcatum, pilis brevibus furfuraceis instructum.

Belgian Congo: Angi, lava plains, on lava, Jan. 21st 1914, *Bequaert 5819*.

Uganda: Kigezi, Kayonza Forest, Ishasha Gorge, cult. & flowered Busingiro, September 1944, *Eggeling 5379;* Kigezi, impenetrable forest, Nov. 1948, *Eggeling 5845;* Toro, 1500 m. alt., on trees in forest, coll. C. H. Lankester, cult. & flowered Kampala, Nov. 26th 1921, *Snowden 736;* Toro, Itwara Forest, Aug. 1943, *Eggeling 5372* (Type).

This species occurs in the region around the main rift valley in East Africa, between Ruwenzori and the Virunga Mountains further south. Although usually a forest plant, it also occurs on lava in the volcanic areas. This is true of a number of other orchids which are normally epiphytic.

Eggelingia clavata *Summerhayes sp. nov.* ab *E. ligulifolia* Summerh. foliis pro rata paulo latioribus, inflorescentiis usque ad 6-floris, floribus minoribus, labelli dimidio apicali clavatim inflato satis differt.

Planta epiphytica. *Caules* singuli vel caespitosi, simplices, saepius ± penduli vel e basi descendente sursum arcuati, graciles, usque ad 35 cm. longi, 2–3 mm. diametro, basi radices flexuosas ramosas emittentes, inferne foliorum delapsorum vaginis fere omnino vestiti, superne laxiuscule foliati. *Folia* circiter 1 cm. distantia; vagina arcta, paulo anceps, leviter transverse rugulosa, internodium aequans vel paulo brevior, apice laminae opposita ligula subulata usque ad 7 mm. longa instructa; lamina sessilis, patens vel ± recurvata, ligulata vel oblongo-ligulata, apice inaequaliter obtuseque bilobulata, lobulo longiore usque ad 6 mm. longo, supra secus medium canaliculata, subcarnosa, 2–5 cm. longa, 5–9 mm. lata. *Inflorescentiae* ex axillis foliorum ortae, brevissimae, 2–6-florae; pedunculus usque ad 3 mm. longus, cataphyllis ochreatis 1–2 ovatis obtusis instructus; rhachis fractiflexa, usque ad 3 mm. longa; bracteae e basi breviter vaginante triangulari-ovatae, subacutae, pedicello cum ovario plus duplo breviores. *Flores* albi vel flavido-albi; pedicellus cum ovario 3–4 mm. longus. *Sepalum* intermedium late lanceolatum, late oblongo- vel elliptico-lanceolatum, acutum vel obtusum, 3–3.75 mm. longum, 1.6–1.9 mm. latum, trinervium; sepala lateralia oblique lanceolata vel late lanceolata, apice acuta, 3.25–4.75 mm. longa, 1.25–1.75 mm. lata, 2–3-nervia. *Petala* oblonga vel oblongo-lanceolata, obtusa, leviter obliqua, 2.25–3.75 mm. longa, 1–1.75 mm. lata, 1–3-nervia. *Labellum* valde concavum, late lanceolatum vel ovato-lanceolatum, leviter acuminatum, 3–3.5 mm. longum, explanatum 2.25–3.25 mm. latum, plurinervium; calcar fere rectum, ore angustum, dimidio apicali clavato-inflatum, apice rotun-

datum, 2.5–4 mm. longum, 1–1.25 mm. diametro. *Columna* crassa, 0.75–1 mm. longa, structura generis; pollinia ovoidea, 0.4–0.5 mm. longa; stipes 1–1.15 mm. longus; viscidium circiter 1 mm. longum; ovarium leviter 6-sulcatum, pilis brevibus furfuraceis instructum.

Gold Coast: Ashanti, Ofinso, Aug. 1938, *Cox 99*.

Gabon: Upper Ngoumyé River, Lake Bandoungou, in forest, Dec. 30th 1924, *Le Testu 5160* (Type).

Belgian Congo: Between Weko and Bengamisa, N. of Stanleyville, around sources of River Ngula, July 16th 1939, *Louis 15484;* Penghe, banks of River Itur, in forest, Feb. 6th 1914, *Bequaert 2334;* Kibale District between Irumu and Mambasa, in forest, Oct. 1931, *Lebrun 4173;* no locality, 1920, *Lacomblez 55*.

This species resembles very closely *E. ligulifolia* Summerh., from which it may be distinguished by the characters given in the diagnosis, particularly the smaller flowers and much swollen spur. It also differs in a number of other less obvious features which can be ascertained by careful comparison of the two descriptions. It is clearly a forest plant, so it will be interesting to see if it turns up in the Cameroons and in the Southern Nigerian forests.

A REVISION OF THE GENUS ANGRAECOPSIS

BY

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THE GENUS *Angraecopsis* was first proposed by Kraenzlin[1] in 1900 for a plant from Usambara in Tanganyika Territory, namely *A. tenerrima* Kraenzl. The author pointed out most of the distinctive characters of the genus, particularly the unequal sepals and the adnation of the laterals to the anticous part of the petals, though he seemed a little confused over the morphological status of the parts concerned. He also stated that there is a single viscidium, but this is clearly the result of faulty observation. Afterwards he appears to have rejected his own genus since he redescribed *A. tenerrima* in 1914 as a species of *Angraecum*.

In his comprehensive account of the Orchidaceae in "Die Orchideen" published in 1914, Schlechter[2] recognises the genus and adds three species to the original *A. tenerrima*. These were *A. parviflora* (Thou.) Schltr. from the Mascarene Islands, *A. ischnopus* (Schltr.) Schltr. from West Africa and *A. falcata* (Thumb.) Schltr. from Japan. He says little about the characters of the genus except to point out that the three-lobed lip separates it easily from *Aërangis* Rchb.f.

A few years later he gives a more complete treatment of the genus in his general revision of the Angraecoid Orchids[3]. In this the number of species has risen to seven,

[1] Engl. Bot. Jahrb. 28 (1900) 171.
[2] Die Orchideen (1914) 600–601.
[3] Beih. Bot. Centralbl. 36, Abt. 2 (1918) 139–141.

in spite of the fact that *A. falcata* has, quite properly, been removed to a separate genus, now known as *Neofinetia* Hu. Three of the added species are from West Africa, the fourth is from the Comoro Islands; all had been described some time previously, but had not been recognised as belonging to *Angraecopsis*.

The latest formal account of the genus is that of the Madagascar species by Perrier de la Bâthie[4], in which five species are enumerated of which three are additions.

All these species have distinct viscidia to the pollinia in spite of any statements to the contrary, though in dried specimens the two viscidia, which often lie side by side, adhere to one another during drying and are difficult to separate on later examination.

Recently several orchids, which seem referable to *Angraecopsis* on general grounds, have been collected in different parts of East Africa. These species, however, all have a common viscidium to the two pollinia. It seems most suitable to include them in a distinct section of the genus.

Examination of all the above forms shows that, although they exhibit considerable diversity in many respects, there is a recognisable facies common to the whole genus, not only as regards the vegetative parts, but also in the floral structure. Characteristic external features are the short stem with a few somewhat oblique curved leaves, the relatively long slender inflorescences and the rather small or very small somewhat spidery flowers. In the latter the lateral sepals are characteristically longer than the intermediate, often somewhat spathulate and projecting together forwards in a parallel position. The petals are triangular, usually with the anticous margin dilated into a forward pointing lobe, the lower part of this being adnate to the base of the lateral sepal; often

[4] Humbert. Fl. Madag. Orchid. 2 (1941) 80–86.

the very acute apex is sharply reflexed so that it is not at first apparent. The lip is commonly trilobed but is almost entire in a few species; the spur has a narrow mouth, but is rather variable otherwise. The rather short acute rostellum projects forward or slightly downward; it is apparently variously cleft after the removal of the viscidia. It should be pointed out, however, that the flowers are rather small and the state of preservation of some of the species is not good enough to be certain of the exact details of the rostellar structure.

As a result of my investigations I now place the total number of recognised species at 14, of which three are newly described later in this paper. Since several of the species are very small plants it seems probable that there may yet be further similar species awaiting discovery; some of the mainland species have been gathered only in the past 20 years or so.

The affinity of *Angraecopsis* appears to be with *Mystacidium*, from which it differs in the unequal sepals, the characteristic petals, the normally 3-lobed lip, the narrow mouth to the spur and the side lobes of the rostellum not being papillose or pubescent.

Angraecopsis Kraenzlin in Engl. Bot. Jahrb. 28 (1900) 171—Schlechter, Die Orchideen (1914) 600–601, et in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 139–141—H. Perrier de la Bâthie in Humbert, Fl. Madag. Orchid. 2 (1941) 80–86.

Herbae epiphyticae. *Caules* breves, usque ad 5 cm. longi, radices flexuosas simplices vel ramosas emittentes, superne paucifoliati. *Folia* disticha, saepius ligulata, sed interdum oblonga vel linearia, saepe ± curvata. *Inflorescentiae* saepissime ex axillis foliorum delapsorum exortae, singulae vel plures, racemosae, pauci- vel pluri- (rarius multi-) florae, pedunculo saepius rhachide longiore.

Flores alternati, parvi vel rarius mediocres, albi virides vel flavo-virides, longiuscule pedicellati; bracteae parvae, basi vaginantes. *Sepala* inter se libera, lateralia quam intermedium saepius longiora ± spathulata et parallele porrecta, interdum omnia sepala ± patentia. *Petala* antice basi cum sepalis lateralibus adnata, saepe oblique triangularia apice reflexa. *Labellum* saepius medio vel infra medium trilobatum vel tripartitum, rarissime integrum, lobis lateralibus brevibus usque interdum intermedium superantibus; calcar ex ore angusto cylindricum vel apice ± inflatum. *Columna* brevis, crassa, apice truncata; androclinium leviter excavatum; anthera ± hemisphaerica, antice breviter producta; pollinia duo, sphaeroidea vel ovoidea, stipitibus duobus linearibus vel rarius superne dilatatis, viscidiis distinctis vel rarius viscidio communi; stigma excavatum; rostellum breviter vel rarius longiuscule productum, saepius porrectum, viscidiis amotis ± 2–3- lobatum vel partitum.

Species typica: *A. tenerrima* Kraenzlin.

Sectio 1. *Eu-angraecopsis* Summerhayes *sect. nov.*

Plantae parvae vel mediocres: pedunculus rhachidem aequans vel saepius longior; sepala valde inaequalia; petala triangularia vel fere dolabriformia margine antico valde dilatata, acuta; labellum trilobatum vel tripartitum, lobis lateralibus saepius linearibus vel ligulatis; polliniorum stipites pro rata longi, viscidiis distinctis parvis.

Species 10, Africae tropicae et Insulae Mascarenarum indigenae.

Species typica sectionis: *A. tenerrima* Kraenzlin.

Sectio 2. *Cardiochilus* Summerhayes *sect. nov.*

Planta pusilla; pedunculus rhachide saepius brevior; rhachis fractiflexa; sepala inaequalia; petala elliptico-ovata, rotundata; labellum integrum, basi leviter cordatum; polliniorum viscidia distincta.

Species unica sectionis, Africae tropicae indigena: *A. pusilla* Summerhayes.

Sectio 3. *Coenadenium* Summerhayes *sect. nov.*

Plantae parvae; pedunculus rhachidem aequans vel brevior; sepala ± inaequalia; petala ovata vel lanceolata, margine antico vix dilatata, subacuta; labellum trilobatum vel integrum, lobis lateralibus brevibus dentiformibus; polliniorum viscidium commune, pro rata magnum, stipites saepius geniculatim conniventes.

Species 3, Africae tropicae orientali indigenae.

Species typica sectionis: *A. breviloba* Summerhayes.

KEY TO SPECIES

Pollinia with 2 separate stipites and viscidia

Petals triangular or broadly triangular with the anticous margin much dilated, adnate to the lateral sepals along the lower anticous margin, apex acute usually sharply reflexed

Spur 2.5 cm. or more long; relatively large plants with ligulate leaves 7–20 cm. in length; lip distinctly trilobed; petals markedly triangular; lateral sepals ± spathulate, much longer than the dorsal sepal; peduncle long, flowers about 6–12, spaced out rather laxly along the rhachis

Lateral lobes of lip from slightly shorter to slightly longer than the middle lobe, broad and obscurely lobulate at the apex; petals much broader than long; spur 5–6.5 cm. long; leaves usually from 1.5–2.5 cm. broad, narrower in small individuals . . . . . 2. *tenerrima*

Lateral lobes of lip much shorter and narrower than the middle lobe, quite entire; petals about as long as broad; spur 2.5–4.5 cm. long; leaves usually 7–15 mm. broad, rarely broader . . . . . 3. *gracillima*

Spur less than 2 cm. long, usually much shorter

Lateral lobes of lip well developed, never less than half the length of the middle lobe

Spur shorter than the lip, much swollen at the apex; lateral lobes of lip about as long as or longer than the middle lobe; petals slightly longer than broad, 1-nerved; lateral

sepals not markedly spathulate; small plants with leaves up to 8 cm. long

Spur nearly 4 mm. long; rhachis about equalling the peduncle, 6–17-flowered; lateral sepals 4.5–5.5 mm. long; leaves broadly ligulate, 6–10 mm. broad

7. *dolabriformis*

Spur about 2 mm. long; rhachis shorter than the peduncle, 6–7-flowered; lateral sepals 3.5–4.5 mm. long; leaves linear, 2–6 mm. broad . . . . . 8. *tridens*

Spur longer, often much longer, than the lip, usually not much swollen at the apex

Petals broader than long (length measured from apex to base of central vein)

Leaves small, elliptical-lanceolate or oblong, up to 5 cm. long and 12 mm. broad; inflorescences 4–6 cm. long; rhachis about as long as peduncle, about 5–7-flowered; lateral lobes of lip slightly longer than the middle lobe; spur about twice as long as the lip, not at all swollen . . . . . 1. *ischnopus*

Leaves large, strap-shaped, 20–35 cm. long, 2.5–3.25 cm. broad; inflorescences at least 10 cm. long, rhachis much shorter than peduncle, 10–20-flowered; lateral lobes of lip distinctly shorter than middle lobe; spur longer than the lip, swollen at the apex

4. *macrophylla*

Petals longer than broad

Leaves broadly strap-shaped or elliptical-oblong, scarcely curved, 10–24 mm. broad; petals 3-nerved

Leaves elliptical-oblong, 4–10 cm. long, 10–24 mm. broad, with two slightly unequal rounded lobes at the apex; inflorescences up to 15 cm. long, rhachis 2–4.5 cm. long, 7–13-flowered; lip about 4.5 mm. long, lateral lobes much shorter and narrower than the middle lobe, spur 5–8 mm. long 5. *elliptica*

Leaves broadly strap-shaped, 9–15 cm. long, 11–22 mm. broad, unequally lobed at the apex; inflorescences 12–22 cm. long, rhachis 4–9 cm. long, 10–25-flowered; lip about 6.5 mm. long, lateral lobes nearly as broad and as long as the middle lobe, spur about 16 mm. long . . . . . 6. *trifurca*

Leaves narrowly strap-shaped, usually somewhat

curved, up to 18 cm. long but only 4–12 mm. broad, acute or very unequally lobed at the apex with the shorter lobe usually tooth-like; petals 1-nerved; inflorescences up to 17 cm. long, rhachis short, 1–3.5 cm. long, up to 12-flowered; lip less than 4 mm. long, lateral lobes distinctly shorter than the middle lobe, spur 6–9 mm. long . . . . . 9. *parviflora*

Lateral lobes of lip very small, spreading; flowers very small (dorsal sepal 2 mm. long); lip more or less cruciform with very short side lobes and thickened apex; spur longer than the lip, much swollen at the apex; leaves ligulate, 2 cm. long, 4–7 mm. broad . . . . . 10. *Pobeguinii*

Petals rounded ovate, anticous margin scarcely dilated, adnate to lateral sepals for a short distance at the base; lip entire, broadly ovate, truncate or slightly cordate at the base; spur slightly longer than the lip; leaves linear, 1.5–5 cm. long, 1.5–5 mm. broad; rhachis ± zigzag, flowers 5–10 mm. apart 11. *pusilla*

Pollinia with 2 separate stipites but a common viscidium; petals not much differentiated from the dorsal sepal, only shortly adnate to the lateral sepals

Lip quite entire or with very obscure rounded side lobes, broadly ovate, spur about 2 cm. long; stipites of pollinia long and slender, not geniculate, viscidium convex, ovate; leaves ligulate, up to 9 cm. long and 1 cm. broad . . . . . 12. *holochila*

Lip with distinct acute tooth-like side lobes about or below the middle, linear and very fleshy, spur 12 mm. long or less; stipites of pollinia short and thick, geniculately connivent, viscidium oblong; dorsal sepal 3–4 mm. long; leaves very small, usually less than 2.5 cm. long

Spur scarcely inflated in the apical part, 10–12 mm. long; side lobes at or just below the middle of the lip 13. *amaniensis*

Spur markedly inflated in the apical part, about 4.5 mm. long; side lobes well below the middle of the lip 14. *breviloba*

Enumeration of Species

Section 1. *Eu-angraecopsis* Summerhayes

This section contains all the species in which the characteristic features of the genus are best developed. In particular the long more or less spathulate forward-

projecting lateral sepals give the flower a distinct and readily recognised facies. The species vary from small plants with a few leaves about 3–4 cm. long up to the imposing *A. macrophylla* in which the strap-shaped leaves reach a total length of 35 cm. These are very reminiscent of the leaves in certain species of *Chamaeangis* and *Diaphananthe*.

1. **Angraecopsis ischnopus** (*Schltr.*) *Schlechter*, Die Orchideen (1914) 601, et in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 140 — Summerhayes in Hutchinson & Dalziel, Fl. West. Trop. Afr. 2 (1936) 462.

Angraecum ischnopus Schlechter in Notizbl. Bot. Gart. Berlin 4 (1905) 170.

Sierra Leone: Loma Mountains, E. slope of Mt. Bintumane, Oct. 1944, *Jaeger 289*.

French Guinea: Nimba Mountains, in mountain forest, Sept. 1947, *Schnell 3729;* same locality, Oct. 1947, *Schnell 3851*.

British Cameroons: Buea, *Deistel* (Type).

This species is characterised by the broad petals, these being considerably broader than long, and the rather long slender spur. The rhachis is about the same length as the peduncle, the few flowers being spaced out at relatively long intervals. The Sierra Leone specimen is in fruit only, but appears to be correctly placed in this species.

2. **Angraecopsis tenerrima** *Kraenzlin* in Engl. Bot. Jahrb. 28 (1900) 171 — Schlechter in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 141.

Angraecum tenerrimum Schlechter in Engl. Bot. Jahrb. 38 (1906) 164.

Angraecum amaniense Kraenzlin in Engl. Bot. Jahrb. 51 (1914) 396.

Tanganyika Territory: East Usambara Mountains, Ngwelo (Nquelo) Forest, June 1899, *Scheffler;* Amani, *Braun 3211;* Ndola, 960 m.

alt., evergreen forest, May 1950, *Verdcourt & Greenway 216;* Kwamkuyu Falls, 840 m. alt., on rock scarp by waterfall, Jan. 1931, *Greenway 2845;* Mahenge Distr., Muhulu Mountains, 1200 m. alt., in mist forest, Feb. 1932, *Schlieben 1844.*

This and the next species, *A. gracillima* (Rolfe) Summerh., may be distinguished from all other species by the long spur, which reaches a length of 2.5 6.5 cm. *A. tenerrima* has the longest spur in the genus, from 5 - 6.5 cm. in length, and may also be distinguished from *A. gracillima* by the nature of the lateral lobes of the lip. In the present species these are as long as the middle lobe and almost parallel-sided to the apex which is often obscurely lobed or bluntly toothed, whereas in *A. gracillima* the lateral lobes are shorter, often much shorter, than the middle lobe and quite entire at the apex.

3. **Angraecopsis gracillima** (*Rolfe*) *Summerhayes* in Kew Bull. (1937) 465.

Mystacidium gracillimum Rolfe in Kew Bull. (1913) 144 — Schlechter in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 126.

Belgian Congo: Between Masisi and Walikale, 1300 m. alt., in transition forest, March 1932, *Lebrun 5156;* Kamatembe, Bishakishaki River, N.W. of Mt. Nyamlagira, April 1934, *De Witte 1516;* Nyamlagira, Kanamaharagi Lava, 1600 m. alt., in sclerophyllous vegetation, Feb. 1945, *Germain 3599;* Goma, by Lake Kivu, in lava plains, 1650 m. alt., in forest, March 1948, *Purseglove 2616.*

Uganda: Toro District, 1800 m. alt., in forest, flowered Botanic Gardens, Entebbe, May 1939, *Chandler 2792;* Ankole District, Lake Lutoto, flowered Busingiro, Sept.–Oct. 1944, *Eggeling 5470;* Mengo District, Mabisa Forest, July 1908, *Brown 444* (? Iso-Type); Masaka District, South Buddu, *Fyffe 184;* Mbale District, Mt. Elgon, Tracey Falls, 1650 m. alt., July 1917, *Snowden 505;* Mt. Elgon, 1800 m. alt., in forest, June 1924, *Snowden 902.*

Kenya Colony: North Kavirondo District, Kakamega-Kaimosi Forests, 1500 m. alt., flowered Nairobi Sept. 1938, *Cunningham–Van Someran 47;* Kakamega Forest, 1200 m. alt., April 1938, *Van Someran* (Coryndon Museum no. 8411); same locality, 1650 m. alt., in forest, Aug. 1942, *Tweedie 590;* South Kavirando District, Kisii, 1500 m.

alt., *Napier* (Coryndon Museum no. 6355); Kericho District, Sotik, Kipsonoi River, 1500 m. alt., *Gray;* Chepalungu Forest, 1800 m. alt., on dead *Acacia* in grassland, *Honoré 2544.*

Evidently widely spread in the East African forest regions. The differences between this and *E. tenerrima* Kraenzl. are given under that species and in the key. The leaves are normally narrower in this species, but one gathering from the Belgian Congo (*Lebrun 5156*) has leaves as broad as those of *E. tenerrima.*

4. **Angraecopsis macrophylla** *Summerhayes sp. nov.* affinis *A. gracillimae* (Rolfe) Summerh., a qua foliis multo majoribus, inflorescentiis densifloris, calcari plus duplo breviore apice inflato satis differt.

Herba epiphytica; caulis brevis, usque ad 5 cm. longus, decurvatus, inferne radices flexuosus ramosas verrucosas 1–2 mm. diametro emittens, superne paucifoliatus. *Folia* omnia pendentia, ligulata, ± curvata, basi leviter angustata, apice valde inaequaliter bilobulata, lobulo breviore brevissimo vel fere nullo, lobulo longiore usque ad 2 cm. longo, obtuso vel subacuto, in toto 15–35 cm. longa, 1.5–3.5 cm. lata, subcarnosa, dorso leviter carinata, pallide viridia; vagina 2–3 cm. longa, compressa, siccitate striata. *Inflorescentiae* ex axillis foliorum delapsorum exortae, patentes vel ± dependentes, circiter 15 cm. longae, simpliciter racemosae; pedunculus teres, 11–12 cm. longus, 1–1.5 mm. diametro, vaginis circiter 5 dissitis arctis acutis dorso carinatis usque ad 5 mm. longis instructus; rhachis quam pedunculus paulo crassior, leviter fractiflexa, 2.5–3.5 cm. longa, dense usque ad 20-flora; bracteae breviter ochreatae, triangulares, acutae, 1–2 mm. longae. *Flores* patentes, de colore nil constat; pedicellus cum ovario fere 1 cm. longus. *Sepalum* intermedium erectum, late oblongo-ovatum, apice rotundatum, convexum, circiter 2.5 mm. longum et 2

mm. latum; sepala lateralia subspathulato-ligulata, incurvata, parallele porrecta, circiter 5.5 mm. longa et superne 1.75 mm. lata; omnia sepala trinervia. *Petala* oblique triangularia, margine antico valde dilatata sepalo laterali adnata, apice angustata, acuta, dimidio superiore reflexa, 2.5 mm. longa, basi 2.8 mm. lata, subtrinervia. *Labellum* basi utrinque angulatum, superne trilobatum, 5.5 mm. longum; lobus intermedius oblongus, sursum sensim angustatus, obtusus, 2.5 mm. longus, 1 mm. latus; lobi laterales divergentes, lineari-oblongi, apice subacuti, 1.25 mm. longi, 0.6 mm. lati; calcar valde circinatim incurvatum, ex ore angusto cylindricum, apice clavato-inflatum, obtusum, circiter 1 cm. longum. *Columna* leviter incurvata, semiteres, fere 2 mm. longa, apice truncata; androclinium leviter excavatum; anthera hemisphaerica, antice in appendicem obtusam producta; pollinia ellipsoidea, 0.6 mm. longa, stipitibus linearibus superne subspathulato-dilatatis 0.8 mm. longis, viscidiis distinctis oblongis convexis 0.8 mm. longis; rostellum productum, obtusum, viscidiis amotis trifidum; fovea stigmatica orbicularis; ovarium circiter 2.5 mm. longum, leviter 6-sulcatum.

Uganda: Bunyoro, Budongo Forest, Siba block, by stream, June 1944, flowered Busingiro, July 1944, *Eggeling 5386* (Type).

This species is easily recognisable on account of the very large leaves. In floral structure it resembles *A. gracillima* (Rolfe) Summerh., but has a much shorter clavate spur. An interesting feature is the widening of the claw of the lip just in front of the spur opening to produce two rounded angles which may be looked upon as the ends of the decurrent sides of the column, though there is no true foot in this genus.

5. **Angraecopsis elliptica** *Summerhayes sp. nov.* affinis *A. trifurcae* (Rchb.f.) Schltr., sed foliis anguste

vel oblongo-ellipticis apice minus inaequilobatis, inflorescentiis brevioribus, floribus minoribus, labelli lobis lateralibus quam intermedio satis minoribus, calcari breviore differt.

Herba epiphytica, radicibus exceptis glaberrima. *Caulis* brevis, usque ad 3 cm. longus, inferne radices flexuosas ramosas pubescentes 2–3 mm. diametro emittens, superne circiter 4-foliatus. *Folia* disticha, recurvatim patentia; vagina compressa, siccitate multistriata, 1–1.5 cm. longa; lamina anguste vel elongato-elliptica, apice paulo inaequaliter bilobulata, lobulis rotundatis vel obtusis longiore vix 5 mm. longo, 4.5–10.5 cm. longa, 1.7–2.5 cm. lata, supra secus medium canaliculata, subtus leviter carinata, subcarnosa. *Inflorescentiae* ex axillis foliorum delapsorum exortae, simpliciter racemosae, 10–15 cm. longae, subdense usque ad 13-florae; pedunculus gracilis, teres, 8–10 cm. longus, vaginis paucis arctis acutis 3–4 mm. longis instructus; rhachis levissime fractiflexa; bracteae ochreatae, apice acutae, usque ad 2 mm. longae. *Flores* incurvatim adscendentes, virides, hyalini; pedicellus cum ovario circiter 5 mm. longus. *Sepalum* intermedium erectum vel leviter incurvatum, lanceolato-ovatum, acutum, circiter 2.25 mm. longum et 1.25 mm. latum, trinervium; sepala lateralia parallele porrecta, oblique et incurvatim oblanceolata, circiter 4.75 mm. longa et 1.5 mm. lata, subquadrinervia. *Petala* triangularia, margine antico rotundato-dilatata sepalo laterali adnata, apice acuminata reflexa, circiter 2.25 mm. longa, basi 2 mm. lata, trinervia. *Labellum* ± incurvatum, ex ungue oblongo trilobatum, 4.5 mm. longum; lobus intermedius lineari-lanceolatus, acutus, circiter 2.75 mm. longus, basi 0.75 mm. latus; lobi laterales lineares, divergentes, 1.6 mm. longi, basi 0.25 mm. lati; calcar cylindricum, incurvatum, apice haud inflatum, circiter 5 mm. longum. *Columna* brevis, crassa, circiter 1.25 mm. longa, apice

truncata; androclinium leviter excavatum; anthera non visa; pollinia ellipsoideo-globosa, 0.5 mm. longa, stipitibus linearibus 0.3 mm. longis, viscidiis distinctis quadratis minutis; rostellum breviter productum, viscidiis amotis breviter bidentatum; ovarium leviter 6-sulcatum, circiter 2.5 mm. longum.

British Cameroons: Buea, 900 m. alt., 1947, *Gregory 194* (Type).

Chiefly recognisable by the relatively broad oblong-elliptical leaves. In floral structure it is nearly related to the Comoro Islands *A. trifurca* (Rchb.f.) Schltr. It is a larger plant than either of the other three species from this general region (*A. ischnopus* (Schltr.) Schltr., *A. dolabriformis* (Rolfe) Schltr. and *A. tridens* (Lindl.) Schltr.) and may also be distinguished by the details of the flowers. A specimen collected by J. W. Purseglove (no. 2614) at Goma near Lake Kivu in the Belgian Congo, is probably also referable to this species, but the plants are considerably smaller and unfortunately none of the flowers is preserved completely.

6. **Angraecopsis trifurca** (*Rchb.f.*) *Schlechter* in Beih. Bot. Centralbl. 33, Abt. 2 (1915) 428 et in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 141 — ? Perrier de la Bâthie in Humbert, Fl. Madag. Orchid. 2 (1941) 82.

Aëranthus trifurcus Reichenbach filius in Flora 68 (1885) 540.

Mystacidium trifurcum Durand & Schinz, Consp. Fl. Afr. 5 (1895) 55.

Listrostachys trifurca Finet in Mém. Soc. Bot. France 9 (1907) 51, ? *excl. descr. et ic.*

Mystacidium Thouarsii Finet, l.c. 57, *quoad descr. et ic., excl. syn. et plantae Mauritianae et Borbonicae.*

Angraecopsis Thouarsii H. Perrier in Humbert, Fl. Madag. Orchid. 2 (1941) 84, *excl. syn.*

A. comorensis Summerhayes in Kew Bull. (1949) 443.

Comoro Islands: Grande Comore, *Humblot 450* (Type in Herb. Vienna); Grande Comore, June 1899, *Pobéguin*.

Comparison of the type of *Aëranthus trifurcus* Rchb.f. in the Vienna Herbarium (*Humblot 450*) with the material collected by Pobéguin and described by Perrier de la Bâthie as *Angraecopsis Thouarsii* shows that they are conspecific. The petals in the Reichenbach type are trinerved, while the side lobes of the lip are nearly as broad and not quite so long as the middle lobe, just as in the Pobéguin specimens.

I am rather puzzled as to the true nature of the material in the Paris Herbarium under the same number as the type, *Humblot 450*, which was figured and described by both Finet and Perrier. These drawings and descriptions clearly do not agree with the type specimen at Vienna, and it is therefore possible that Humblot collected a mixture of species under his number *450*. An alternative explanation is that both French authors have placed too much dependence on the drawings of the artist C. Kastner which appear in both Finet's plates and as parts of Perrier de la Bâthie's illustrations. Examination of drawings by this artist on sheets of other species in the Paris Herbarium shows that they are sometimes highly imaginative and do not agree with my dissections of flowers from the same plants. It seems therefore possible that the drawings on the sheet of *Humblot 450* are also inaccurate and have led to a misinterpretation of the material; clearly a re-examination of this specimen is desirable.

7. **Angraecopsis dolabriformis** (*Rolfe*) *Schlechter* in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 140 — Dandy in Excell, Cat. Vasc. Pl. S. Tomé (1944) 335.

Mystacidium dolabriforme Rolfe in Bolet. Soc. Broter. 9 (1891) 141 et in Dyer, Fl. Trop. Afr. 7 (1897) 175

— Durand & Schinz, Consp. Fl. Afr. 5 (1895) 52 — Henriques in Bolet. Soc. Broter. 27 (1917) 183.
Angraecum dolabriforme Engler in Engler & Drude Veget. der Erde 9, bd. 2 (1908) 419.

Sao Tome: no locality, *Henriques*, cult. in Hort. Coimbra in 1889 and in Herb. Kew (Type).

This and the next species (*A. tridens* (*Lindl.*) *Schltr.*) are clearly closely allied and further material may show that they are conspecific. *A. dolabriformis* has broader leaves, more flowers in the inflorescence, slightly larger flowers and a longer spur than *A. tridens*, but it remains to be seen if these are valid distinctions or merely represent plants of different degrees of robustness.

8. **Angraecopsis tridens** (*Lindl.*) *Schlechter* in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 141 — Summerhayes in Hutchinson and Dalziel, Fl. West Trop. Afr. 2 (1936) 462.
Angraecum tridens Lindley in Journ. Linn. Soc. Lond. Bot. 6 (1862) 136.
Listrostachys tridens Reichenbach filius in Flora 48 (1865) 190 — Durand & Schinz, Consp. Fl. Afr. 5 (1895) 50.
Epidorchis tridens O. Kuntze, Rev. Gen. Pl. (1891) 660.
Saccolabium occidentale Kraenzlin in Engl. Bot. Jahrb. 17 (1893) 57.
Angraecum occidentale Rolfe in Dyer, Fl. Trop. Afr. 7 (1897) 142.
Mystacidium tridens Rolfe, l.c. 174.
Angraecopsis occidentalis Schlechter in Beih. Bot. Centralbl. 36, Abt. 2 (1918) 140.

British Cameroons: Cameroon Mt., W. of Buea, 1240 m. alt., in primeval forest, Sept. 21st 1891, *Preuss 965*.
Fernando Po: no locality, 1200 m. alt., Dec. 1860, *Mann 646* (Type).

The distinctions between this and *A. dolabriformis* (Rolfe) Schltr. are mentioned under that species. Both species are characterised by the short inflated spur.

9. **Angraecopsis parviflora** (*Thou.*) *Schlechter*, Die Orchideen (1914) 601 et in Beih. Bot. Centralbl. 33, Abt. 2 (1915) 428 et l.c. 36, Abt. 2 (1918) 140 — Perrier de la Bâthie in Humbert, Fl. Madag. Orchid. 2 (1941) 85.

Angraecum parviflorum Thouars, Orch. Iles Austr. Afr. (1822) t. 60 — A. Richard, Orch. Iles France & Bourbon (1828) 70 — Bojer, Hort. Maurit. (1837) 317.

Aërobion parviflorum Sprengel, Syst. Veg. 3 (1826) 718.

Oeceoclades parviflora Lindley, Gen. & Sp. Orch. Pl. (1833) 236.

Listrostachys parviflora S. Moore in Baker, Fl. Maurit. Seych. (1877) 355 — Durand & Schinz, Consp. Fl. Afr. 5 (1895) 49.

Epidorchis parviflora O. Kuntze, Rev. Gen. Pl. (1891) 660.

Saccolabium parviflorum Cordemoy, Fl. Ile Réunion (1895) 197.

Mystacidium pedunculatum Rolfe in Dyer, Fl. Trop. Afr. 7 (1897) 175.

Tanganyika Territory: Kyimbila District, N. of Lake Nyasa, *Stolz K. 51.*

Nyasaland: Mt. Milanji, 1200 m. alt., *McClounie 29;* Manganja Mts., Mt. Chiradzulu, Sept. 1861, *Meller.*

Portuguese East Africa: Makua Country, Namuli Mts., *Last.*

Southern Rhodesia: Umtali District, Vumba, Norseland, 1500 m. alt., in kloof forest, March 1949, *Wild 2799* (S. Rhodesian Gov. Herb. No. 22724); Melsetter District, Lucite Valley, 1200 m. alt., Feb. 24th 1907, *Johnson 175.*

Madagascar: Manongarivo Mts., 1000 m. alt., in forest, March 1909, *Perrier 1947.*

Mauritius: no locality, *Thouars 30* (Type); *Grey; Bojer; Commerson* (according to Bojer the species occurred in forests on the Pouce and Picter. Both mountains and at Plaines-Wilhems).

Reunion: Mont St. François, S. of St. Denis, *Richard 507;* no locality, *Richard 406; Boivin 1060; Herb. Drake* (common at St. Benoit according to Cordemoy).

Careful examination and comparison of all these specimens indicate that they are referable to the same species. The specimens from the African mainland are on the whole larger than those from Mauritius and Réunion, but there is practically no difference between the smallest mainland plants and the largest island specimens. In floral structure there is very close agreement, at any rate as regards the two Southern Rhodesian gatherings of which I have seen well preserved flowers.

Finet [5] provides a description and figures of two gatherings (*Sacleux 764* and *765*) from Portuguese East Africa which he identifies with Rolfe's *Mystacidium pedunculatum*. Although there are no properly preserved flowers on Rolfe's material, in several cases the spur still remains. This, even allowing for shrinkage, could not possibly have exceeded 1 cm. in length and was probably nearer 7 mm., which is about the length of the spur in *Angraecopsis parviflora*. On the other hand the flowers figured by Finet have a spur which appears, from the magnifications given, to be about 2 cm. long with quite a wide mouth. This certainly does not agree with the shrivelled-up spurs on the capsules of *M. pedunculatum*. It therefore seems almost certain that Sacleux's plants are referable to a different species, which is correctly placed in *Mystacidium*, with which they agree in floral structure, especially the lip and rostellum-lobes.

It should be further pointed out that in no true species of *Mystacidium* are the flowers bunched at the end of the inflorescence with a long peduncle below, but are spaced out evenly along the greater part of the inflorescence so that the peduncle is comparatively short. In

[5] Mém. Soc. Bot. France 9 (1907) 57, t. XII, fig. 1–12.

Angraecopsis, on the other hand, a long slender peduncle is a very common occurrence, the flowers being closely placed along the comparatively short rhachis. All this evidence supports the view that the original *Mystacidium pedunculatum* of Rolfe is correctly referred to *Angraecopsis parviflora* and has nothing to do with the plants figured under the same name by Finet.

A. parviflora is clearly related to *A. trifurca* and *A. elliptica* as regards the floral structure; the differences between the species are indicated in the key.

10. **Angraecopsis Pobeguinii** (*Finet*) *Perrier de la Bâthie* in Humbert, Fl. Madag. Orchid. 2 (1941) 81, fig. LI, 1–7.

Rhaphidorhynchus Pobeguinii Finet in Mém. Soc. Bot. France 9 (1907) 41, t. VII, fig. 46–54.

Chamaeangis Pobeguinii Schlechter in Beih. Bot. Centralbl. 33, Abt. 2 (1915) 426 et l.c. 36, Abt. 2 (1918) 111.

Comoro Islands: Grande Comore, June 14th 1899, *Pobéguin* (Type in Herb. Paris).

This species is easily recognisable by the small flowers and the very short side lobes to the lip. These stand out almost at right angles so that the whole lip appears cross-shaped; the apex of the middle lobe is much thickened and fleshy.

In the original description and illustrations of the species the two pollinia are shown as possessing a common stipes and viscidium. I was not able to discover the pollinarium on examining a flower on the type specimen, but I very much doubt the accuracy of Finet's account in this respect. One wonders if the imagination of the artist, C. Kastner, is again here in evidence, as suggested under *A. trifurca*. In this connection it may possibly be significant that Perrier de la Bâthie does not reproduce

the drawings of the pollinarium, though all the other dissections from the type sheet appear on his plate; neither does he mention the common stipes and viscidium in his specific or generic descriptions. Instead he points out that the two stipites and viscidia are sometimes coalescent; I can confirm that this happens in dried material of many species of the genus, though the viscidia are clearly distinct in fresh or alcohol material.

Section 2. *Cardiochilus* Summerhayes

This section contains only one species, a small insignificant plant with narrow leaves and few-flowered lax inflorescences of small greenish-white flowers. In this section the petals are only slightly differentiated from the dorsal sepal and the line of attachment to the lateral sepal is very short. The entire broadly ovate lip with slightly cordate base is also a characteristic feature. Nevertheless, the combination of characters present seems to link the plant most closely with *Angraecopsis* of which, however, it is clearly an aberrant species.

11. **Angraecopsis pusilla** *Summerhayes sp. nov.*

Herba epiphytica nana, tota usque ad 7 cm. alta. *Caulis* erectus, brevis, usque ad 2 cm. longus, inferne radices flexuosas carnosas glabras emittens, superne crebre 5–9-foliatus. *Folia* ± erecta vel adscendentia; vagina compressa, 5–8 mm. longa, siccitate pluricostata; lamina linearis vel lineari-ligulata, apice inaequaliter bilobulata lobulo breviore fere nullo longiore rotundato, 1.5–5 cm. longa, 1.5–5 mm. lata, sectione leviter V-formis, carnosula. *Inflorescentiae* ex axillis foliorum exortae, graciles, superne laxe 4–7-florae; pedunculus gracilis, teres, 1–3 cm. longus, vaginis perpaucis arctis acutis usque ad 4 mm. longis instructus; rhachis gracilis, flexuosa; bracteae lanceolatae, dimidio inferiore vaginantes, apice acutae, 1.5–2.5 mm. longae, extra carinatae. *Flores*

5–10 mm. distantes, erecto-patentes, albi, viridi-tincti; pedicellus cum ovario 5–8 mm. longus, gracilis. *Sepalum* intermedium leviter incurvatum, convexum, orbiculari-ovatum, apice obtusissimum, circiter 1.75 mm. longum et paulo angustius quam longius, subtrinervium; sepala lateralia subspathulatim oblanceolata, curvata, apice obtusa, circiter 2.75 mm. longa et 1 mm. lata, uninervia. *Petala* late oblique elliptico-ovata, apice rotundata, margine antico paulo dilatata sepalo laterali adnata, circiter 2 mm. longa et 1.6 mm. lata, binervia, nervis ramosis. *Labellum* concavum, late ovatum, apice subacutum, basi truncatum vel leviter cordatum, 2.5 mm. longum, explanatum circiter 2 mm. latum, trinervium; calcar fere rectum, ex ore angusto cylindricum, sursum sensim angustatum, apice rotundatum, circiter 2.75 mm. longum. *Columna* fere recta, brevis, crassa, subteres, 1 mm. longa; androclinium leviter excavatum; anthera hemisphaerica, antice brevissime producta; pollinia sphaeroidea, circiter 0.3 mm. diametro, stipitibus duobus linearibus polliniis brevioribus, viscidiis duobus distinctis ellipticis parvis; rostellum incurvatim porrectum, viscidiis amotis indivisum; ovarium plurisulcatum, circiter 1.75 mm. longum.

Belgian Congo: Parc National Albert, between Nyamlagira and Tsambene, 1700 m. alt., in forest, Jan. 16th 1945, *Germain 3432* (Type in Herb. Brussels).

Described from both dried and alcohol material. Possibly with a wider distribution in the upper forests of the Central African mountain region, but easily overlooked on account of its small size and insignificant flowers.

Section 3. *Coenadenium* Summerhayes

The species of this section are characterised by the possession of a common viscidium to the two pollinia, though the stipites are distinct. Apart from the pollinarium, the species exhibit the characteristic *Angrae-*

copsis floral facies more clearly than the species in the last section, though not so markedly as the species of sect. *Eu-angraecopsis*. They are all small plants with rather short inflorescences in which the rhachis occupies the upper half or more, the peduncle being comparatively short. All the species are natives of East Tropical Africa.

12. **Angraecopsis holochila** *Summerhayes* in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 115.

UGANDA: Karamoja District, Napak, 2250 m. alt., in ravine forest, May 28th 1940, *Thomas 3646* (TYPE); same locality, 2190–2250 m. alt., on trees and rocks, June 1950, *Eggeling 5971*.

Characterised by the almost entire lip and relatively long spur. The large ovate very convex viscidium is truncate and slightly emarginate in front; the stipites arise laterally, are almost straight or slightly curved and in length much exceed the diameter of the pollinia. Further material in alcohol collected recently by Dr. W. J. Eggeling has confirmed in all respects the striking features of this delightful little species.

13. **Angraecopsis amaniensis** *Summerhayes* in Bot. Mus. Leafl. Harvard Univ. 11 (1945) 259.
A. tenuicalcar Summerhayes, l.c. 258.

KENYA COLONY: Mt. Elgon, south side, 2160 m. alt., in *Podocarpus* forest, April 1943, coll. E. W. Carroll, comm. *E. M. Tweedie 603*.
TANGANYIKA TERRITORY: West Usambara Mts., Shume, edge of forest, March 25th 1942, *Moreau 325;* East Usambara Mts., Amani, 900 m. alt., on exotic conifers, July 4th 1941, *Moreau 68* (TYPE).

Since describing the above two species, I have seen further material, including flowers in alcohol of *Moreau 325*. This additional material shows that, firstly, the supposed difference in the thickness of the spurs of the two species is non-existent and, secondly, the relative lengths of the lateral and intermediate sepals are very variable, intermediates occurring between the conditions described

in my original accounts. It therefore seems more logical to look upon the various gatherings as forms of one species, the general floral structure and especially the column showing very close agreement.

14. **Angraecopsis breviloba** *Summerhayes* in Bot. Mus. Leafl. Harvard Univ. 11 (1945) 256.

KENYA COLONY: Mgong, 1800 m. alt., in forest, May 7th 1934, *C. Van Someran* (Coryndon Mus. No. 3653); same locality and altitude, May 1932, *Mainwaring 1858* (Coryndon Mus. No. 3104); Ngong and Langata Forest, 1800 m. alt., in dense shade on *Acokanthera Schimperi*, April–May 1950, *Piers 2;* North Nyeri District, Nyeri, Thego River, March–April 1941, *Copley 26;* Tana River basin, steppes of the Thikathika, July 16th 1893, *Gregory*.

TANGANYIKA TERRITORY: Mondul, W. of Arusha, 1800 m. alt., May 6th 1942, *Moreau 304* (TYPE); Mbulu, June 7th 1942, *Moreau 304A;* Kilimanjaro, Marangu, 1350 m. alt., in riverain forest, Nov. 27th 1941, *Moreau 107;* Lolbene Mt., 50 miles S. of Moshi, in forest, coll. F. M. Page-Jones, cult. and flowered Amani, April 10th 1944, *Moreau 815*.

This and the previous species have the short stipites of the pollinia geniculately incurved so that the pollinia lie close to one another. The viscidium is more or less rectangular with the front and back rounded-truncate. The present species may be distinguished from *A. amaniensis* by the shorter much inflated spur.

SPECIES REJICIENDA

Angraecopsis Boutoni (Rchb.f.) Perrier de la Bâthie in Humbert, Fl. Madag. Orchid. 2 (1941) 82.
Angraecum Boutoni Reichenbach filius, Otia Bot. Hamburg. (1881) 117.

Examination of the type specimen of this species shows that it is not an *Angraecopsis* at all, but a *Chamaeangis* closely allied to, if not identical with, *C. Hariotiana* (Kraenzl.) Schltr. I am refraining, however, from making a new combination in *Chamaeangis*, as I am not certain of the correct specific epithet for the species concerned.

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WHENCE CAME MAIZE TO ASIA?

BY

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THE intriguing question of pre-Columbian trans-Pacific diffusion is with us again and modern Kon-Tikis now compete with ancient Alexandrian fleets in the alleged South Pacific Regatta. To the interested but confused onlooker, it might appear that the specialists are divided into two opposing camps with adventurous diffusionists in bitter conflict with obstinate and reactionary proponents of independent invention. To some of the individual specialists involved, the issue may, indeed, have this emotional coloring. Basically, however, the lines are drawn between those who are short on facts and use them uncritically (although sometimes with superb imagination) and those who demand evidence and valid reasoning. In the paper on maize in Assam, which is the principal basis for this critique, neither the authors' selection of facts nor their reasoning from those facts can, in our opinion, support their theory of a pre-Columbian diffusion of maize across the Pacific. In their favor, however, it must be added that they do not profess to know in which direction the diffusion took place.

The question as to which part of the world gave rise to maize is by no means new, since it is one upon which

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students of plants have differed for more than four centuries. Sturtevant, a careful student of maize and of the literature pertaining to it, compiled (1879) lists of names of prominent herbalists and early botanists who had expressed opinions on the geographical origin of maize. Among those who regarded maize as a plant of Old World origin were: Bock, Ruellius, Fuchs, Sismondi, Michaud, Gregory, Lonicer, Amoreux, Regnier, Viterbo, Donicer, Tabernaemontanus, Bonafous, St. John, de Turre, Daru, de Herbelot and Klippart. Equally impressive is the roster of those who believed maize to be an American plant: Dodoens, Camerarius, Matthioli, Gerard, Ray, Parmentier, Descourtilz, de Candolle, Humboldt, Darwin, F. Unger, Von Heer, de Jonnes, Targioni-Tozzetti, Hooker, Figuer, Nuttall, Mrs. Somerville and Flint. De Candolle's case (1855) for the American origin of maize was so convincing and the evidence which he marshalled to support his conclusions so substantial that the possibility of an Old World origin of maize has received little consideration from serious students in more recent times. Especially has this been true since Ascherson (1875) demonstrated the close relationship of maize and teosinte, a plant unmistakably American.

The question of a pre-Columbian distribution of maize in Asia has, however, been raised at least twice in this century, first in 1909 by Collins, and now by Stonor and Anderson (1949). The last named paper, since it purports to present new evidence on the question and coinciding as it does with a fashionable new preoccupation with the old problem of trans-Pacific diffusion of pre-Columbian cultures, has been of particular interest. We have been requested by a number of anthropologists to review it and to evaluate the evidence on which it is based. The paper has already been critically discussed by Merrill (1950), who has questioned its principal con-

clusions on general botanical and ethnological grounds, and by Weatherwax (1950), who has quite appropriately emphasized the important and fundamental differences which exist between maize and its Asiatic relatives, and has simultaneously emphasized the similarities among the American Maydeae. We propose here to examine critically the botanical and ethnographic evidence concerned with maize upon which the far-reaching conclusions of the authors rest.

Stonor and Anderson found the hill peoples of Assam growing a group of maize varieties with characters said to be "unusual" and utilizing them for food, feed, and brewing. This maize which the authors designate as "Race A" is said to be unknown in the coastal regions of Asia, but rather widely distributed in Central Asia; furthermore, it seems to resemble certain South American maize also designated as "Race A" which is common archaeologically and certain features of which are still to be found, although rarely, among living South American varieties. These peculiar Asiatic varieties differ profoundly from those of "Race C" which also occur in both Asia and America, but which in Asia are largely confined to the coastal regions. The introduction of Race C to Asia is admittedly post-Columbian.

These facts are regarded by the authors as "fantastic," and it is stated that "any satisfying hypothesis must border on the miraculous." They conclude that maize presumably "must either have originated in Asia or have been taken there in pre-Columbian times."

The evidence upon which these sweeping conclusions rests falls into three categories: (1) botanical evidence concerning the maize in question; (2) ethnographic evidence on the maize-using tribes and the uses to which maize is put; (3) supporting evidence from Polynesia in favor of trans-Pacific diffusion. We shall consider only

the first two categories, since the third has already been discussed by Merrill and will undoubtedly receive additional attention from others who are better qualified than we to evaluate it.

The Botanical Evidence

The botanical evidence may in turn also be considered under three categories: (a) that the Assamese maize is unique and is related only to archaeological maize in America; (b) that the present distribution of Races A and C can be explained only in terms of a pre-Columbian diffusion of one of them; (c) that Assamese maize resembles sorghum.

Five varieties of maize from Assam are described. The following "unusual" characters are said to typify one or more of these varieties.

1. Uniformly green leaves, culms, silks and anthers.
2. Slender pendent tassel branches.
3. Straw-yellow endosperm; dull bluish-red aleurone.
4. Small isodiametrical kernels.
5. Many short internodes; lack of vegetative vigor.
6. Upright twisted tassel branches; short silks.
7. Tassel partly enclosed in a spathe-like cluster of leaves.
8. A distinct bloom on the leaves and culm.[2]
9. Waxy pollen and endosperm.

These characteristics, although not common, are nevertheless well-known to those familiar with the great diversity of maize in Latin America. Separately most of them are widely distributed not only in South America, but also in Central America and Mexico. Even in com-

[2] This character was not specifically included in their list, but is mentioned separately as one of the characteristics of the variety *Late Sidewise*.

bination they are by no means unique. In this connection the following observations made largely on varieties of maize in the collections of the senior author are pertinent.

1. Uniform greenness resulting from a complete lack of anthocyanin coloration is indeed almost unknown, at least in pure form, in the indigenous maize varieties of Latin America. Virtually all maize, however, has at least a trace of anthocyanin color in the seedlings where it occurs in the coleoptile or leaf sheath, in the tip of the leaf blade, or along the leaf margins. Consequently, if the Assamese varieties are actually completely lacking in anthocyanin pigmentation, they are indeed almost unique. Unfortunately, the authors do not report specifically on anthocyanin color in the seedlings, stating only that: "The group as a whole had a strong tendency to green silks, green anthers, green leaves, and green culms." Plants of this general description are the product of two recessive alleles at the *B* and *Pl* loci on chromosomes 2 and 6 respectively and of one of the lower alleles at the *R* locus on chromosome 10. Such plants are not common, but occur regularly throughout Latin America. In 1950, we grew 513 collections of corn from sixteen Latin-American countries. Among these were 27 varieties which contained plants lacking in anthocyanin color in the leaves, culms, silks and anthers. These occurred in collections from Mexico, Guatemala, Honduras, Nicaragua, Colombia, Ecuador, Peru, Venezuela, Brazil, Uruguay and Paraguay. They had their highest frequency in the varieties of eastern South America. Of 40 varieties from Venezuela, Brazil, Paraguay and Uruguay which were studied in 1950, eight, or one variety in five, contained some uniformly green plants compared to one variety in 19 for the group as a whole. So far as anthocyanin coloration alone is concerned, the Assamese vari-

eties, therefore, have their affinities in the corn varieties of eastern South America.

In so far as uniform greenness has any bearing upon the origin of maize, it points to Asia, not as a center of origin, but as a peripheral region where recessive genes have become "emancipated" through the process of "genetic drift." The counterpart of this situation occurs in rice which in the United States is represented largely by uncolored (green) varieties, but which has colored varieties in the Old World (Jones, 1930). In rice, as in maize, at least three loci are involved in anthocyanin coloration.

2. Pendent tassels, like lack of anthocyanin color, although not common, are found in varieties from several countries, including Mexico, Guatemala, Honduras, Costa Rica, Nicaragua, Venezuela, Colombia, Peru and Ecuador. The combination of pendent tassels and all-green plants occurs in only seven of these nine countries, not having been found in Costa Rica and Honduras. All-green plants with strongly pendent tassels are most common in Colombia where many other of the "unusual" characters of the Assamese maize also occur.

3. Straw-colored endosperm is not at all unusual among non-Tripsacoid varieties. Dull bluish-red aleurone is the product of superimposing blue aleurone on waxy endosperm and is a characteristic quite familiar to the majority of practicing maize geneticists.

4. Small isodiametrical kernels are characteristic of many South American pop corns. Dr. Anderson kindly sent us kernels of several of the Assamese varieties. It was possible to match more than half of these in size, shape and color from a single collection of Colombian pop corns.

5. Lack of vegetative vigor, manifested especially by the slowness of the tassel to reach the pollen-shedding

stage after emergence has begun, is characteristic of many South American and some Mexican varieties. It is surely of little significance in the Assamese varieties which are obviously rather highly inbred, if the statements of the authors are correct regarding their uniformity and the fact that they are sometimes grown as single plants among other cereals. Lack of vigor is characteristic of many American inbred strains.

We have no data on internode pattern.

6. We have no observations on upright tassel branches and short silks.

7. The spathe-like cluster of leaves partly enclosing the tassel is not uncommon in Colombian varieties.

8. The grayish bloom which shows some resemblance to the bloom characteristic of sorghum (and many other grasses) occurs in our collection only on varieties from Colombia.

9. Perhaps the most important "unusual" characteristic of the Assamese maize is the waxy endosperm which occurs in several varieties. It was the discovery of this character in Chinese maize which led Collins (1909) to reopen the question of a pre-Columbian distribution of maize in Asia.

Waxy endosperm is a simple Mendelian character in maize which affects the chemical composition. The starch of waxy maize is composed exclusively of amylopectin, while that of non-waxy varieties contains both amylose and amylopectin. Waxy varieties of maize are unknown in pure form in America, but the waxy character itself has been discovered in non-waxy varieties: in a New England flint corn by Mangelsdorf (1924) and in a South American variety by Breggar (1928). Bear (1944) has found that waxy endosperm is not an uncommon mutant in Corn-Belt dent corn varieties. He found three separate mutations in three consecutive years in a total pop-

EXPLANATION OF THE ILLUSTRATION

PLATE XLVIII. A pendent tassel of one of the Colombian pop-corn varieties which resembles in several characteristics the Assamese race *Late Side-wise* described by Stonor and Anderson. Note, at lower left, the sterile spikelets resulting from the failure of the tassel to emerge completely from the spathe-like sheath. Note, at right, the lax central spike with spikelets borne in whorls at widely separated nodes. Note the solitary spikelets at the ends of several branches.

Plate XLVIII

ulation of some 100,000 selfed ears. It is of interest to note that in the case of one of these mutations Bear found one ear pure for waxy in the line in which waxy endosperm was first noticed. This pure waxy ear was the product of Mendelian segregation and not of human selection.

In Asia, waxy maize is widespread. Collins (1909, 1920) has reported its occurrence in China, Burma and the Philippines. Kuleshov (1928) states that it is spread from 5° to 45° north latitude in Asia.

Is there any significance in the fact that a gene which is comparatively rare in American maize should be widespread in Asia? Certainly there is none from the standpoint of the time required for waxy varieties to become established. It is not at all uncommon for recessive genes which are rare at the center of a plant's origin to become common somewhere at the periphery of its spread. This is a natural consequence of the process already mentioned, "genetic drift," in which recessives with a low frequency may rapidly attain a high frequency as the result of sampling and without the intervention of either natural or artificial selection. So far as waxy endosperm has any bearing upon the origin of maize, it, like the all-green plants discussed above, points to Asia as a peripheral region rather than as a center of origin.

There is, however, undoubtedly other significance in the fact that waxy maize occurs so commonly in a part of the world which also possesses waxy varieties of rice, sorghum and millet. The obvious explanation is that the people of Asia, being familiar with waxy (glutinous) varieties of other cereals and accustomed to using them for special purposes, recognized the waxy character in maize, when that cereal was introduced, and purposely isolated varieties pure for the waxy condition[3]. Because

[3] Burkill (1935) questions, however, whether waxy maize was ever

waxy endosperm is a recessive, this task would have been simple and well within the abilities of even the most primitive hill peoples. Indeed, the practice of growing maize as single plants among other cereals, reported by Stonor and Anderson, would promote self-pollination, and in any stock in which the waxy gene occurred would inevitably lead in a very short time to the establishment of pure waxy varieties whose special properties people accustomed to the waxy character in other cereals could hardly fail to recognize. Man's part in the establishment of waxy varieties of maize in Asia need have been no greater than a recognition of this type and a willingness to preserve it once it was presented to him as the product of random sampling.

But much more important than the individual characters of the Assamese maize is the fact that these characters occur as a "complex" in Asia: a complex which is said to be rare in South America and "nothing like it" to be known in Mexico, Guatemala or other parts of Central America. How accurate is this statement and how valid the conclusions regarding the uniqueness of Assamese maize?

The complex of characters in its entirety has not been reported from Mexico and Central America, but does (if we exclude waxy endosperm as an integral part of the complex) occur in South America. The authors themselves mention two varieties from Chile, one from Argentina, and several from Bolivia which have a number of features in common with the Assamese maize, and they quote Brieger as noting these characteristics in other parts of South America. The most unusual of the Assamese varieties, called *Late Sidewise*, which is said to look

selected for its waxiness and suggests that it was preserved only because of the peculiar suitability of its sheaths for cheroots. This problem merits further study.

"unlike anything previously reported for *Zea Mays*" has strong affinities, if not exact counterparts, among the living varieties of Colombia. In 1949, we noted, in a group of pop-corn varieties sent from the Department of Caldas in Colombia by Dr. J. G. Hawkes, in a pop corn received from Dr. R. E. Schultes collected slightly north of Buenaventura, and in pop corn purchased by the senior author in the market in Bogotá, practically all of the characteristics mentioned in the description of *Late Sidewise*, including the bluish-green color of the leaves and the culms and the distinct bloom which lends to the plants a superficial resemblance to sorghum.

These Colombian pop corns are of unusual ethnographic and botanical interest. They are known locally as *maiz indio* and, according to Dr. Hawkes, they are grown by the Indians in a primitive way, the seed being sown broadcast and the crop receiving no weeding or cultivation from the time of planting until harvest. A similar statement about the method of sowing accompanied the collection made by Dr. Schultes. One of the ears (No. 1355) of the Colombian pop corn (inadvertently shelled off and put into cold storage before a photograph could be made) was almost a duplicate of the ear (Stonor No. 18) illustrated in Plate 21 of Stonor and Anderson. Of seven distinct samples of kernels of Assamese maize sent to the senior author by Dr. Anderson, five could be matched almost exactly in size, shape and color with Colombian pop corns. The pendent tassels of these corns are illustrated in Plate XLVIII. They are of further botanical interest because of the slender, lax central spikes of the tassel, on which the spikelets are borne in distinct whorls separated by conspicuous internodes. The tips of the tassel branches often bear solitary staminate spikelets. The plants tiller profusely and have numerous elongated lateral branches. It was noted in 1949 that: "these

plants look like corn-teosinte hybrids," but there is no other indication that they are the product of recent teosinte contamination.

The complex of characters described for the *Late Sidewise* maize of Assam is, as Stonor and Anderson concluded, an unusual one. It is, however, not unique nor confined to Asia. The fact that it occurs in Asia is not, in our opinion, evidence either that maize originated there or that it was taken there in pre-Columbian times. The maize of Italy is in some respects as unusual as the maize of Assam, but it, too, has American affinities. No maize has yet been found in any part of the Old World which does not have its counterparts in America. The maize of Assam is no exception to this general rule.

The authors make much of the fact that the predominating maize of Assam, Race A, is not represented in collections of the maize from the Asiatic coast, and they ask how such a race of maize could have gotten to a number of isolated hill areas in Asia without leaving a very definite record along the coast. "That maize," they state, "could in post-Columbian times have spread to each of these various hinterlands without entering into the economies of the more civilized people who would have handed it on almost passes belief." And again, "To believe that in post-Columbian times maize could have penetrated not only to the Naga but to the hill tribes of Upper Burma, and of Siam, to the Lolo in central Asia, to the aborigines of Hainan, to the hill peoples of Sikkim, and to the interior of New Guinea, in each case passing over the more civilized peoples along the coast is beyond credulity."

For us it is more difficult to believe that maize could have occurred in pre-Columbian times in all of these places, as well as in the coastal regions where it has now presumably disappeared; and perhaps throughout Cen-

tral Asia from Persia and Turkestan to Tibet and Siberia where it now occurs, without leaving a single prehistoric trace of any kind. Yet there is no tangible evidence of the existence of maize in Asia or any other part of the Old World before 1492. When we consider how thoroughly other economic plants were treated in the extensive ancient literature of Asia and the Near East, and how popular maize became as a cultivated plant and as a subject for artistic treatment after the discovery of America, it taxes our credulity to believe that all of the civilized people of the Old World could have remained ignorant of a food plant at once so widely distributed, so peculiar in its characteristics and so useful to mankind.

Burkill (1935), probably the leading authority on the economic plants of the Far East, came to a similar conclusion. He states: "The strongest reason against the belief [of a pre-Columbian distribution of maize in China] lies in the unanswerable argument that no plant of such value could have remained hidden in the Far East, if there."

Actually the absence of Race A in the coastal regions of Asia is not difficult to explain, if indeed it requires explanation. In the first place, its absence among the very limited collections so far made from the coastal regions of Asia is far from conclusive proof that it does not occur. But if we assume for the purpose of discussion that Race A actually is absent at low altitudes in Asia, then there are several possible explanations which do not require the assumption of pre-Columbian diffusion. An obvious one is that the more productive Tripsacoid varieties of the second race, Race C, have already, in coastal regions, largely replaced the non-vigorous unproductive varieties of Race A, earlier introduced, as they are perhaps in the process of doing in the hills where Race C now also occurs along with Race A. The counterpart of

this process can be observed in many parts of North and South America today.

A second possible answer, probably the correct one, was given, forty years before the question was raised, by Laufer who, as the result of his scholarly historical studies, concluded that maize came into China, not from across the Pacific, but overland through Tibet from India. This conclusion is quite in harmony with the facts of both history and geography. Colombia, for example, where living counterparts of the Assamese maize are now known to occur, is actually appreciably nearer to Assam via the Caribbean Sea, the Atlantic Ocean and Africa than via the Pacific. Furthermore, the first route, being more largely a land route, does not demand the fabulous feats of navigation on the part of pre-Columbian people which the second does.

This does not mean that Laufer's conclusions on the introduction of maize into Asia are necessarily completely correct and final. However, until new evidence in conflict with them is brought forward, they furnish a satisfactory explanation of the facts now at our command. This is recognized by Stonor and Anderson who state that accepting the morphological similarity of American and Asiatic maize as a premise, Laufer "could have come only to the conclusion he finally reached: that maize somehow got to Indian ports at an early post-Columbian date and spread overland via various primitive peoples to China." Since it can now be shown that the Assamese maize is indeed similar to American maize, the evidence presented by Stonor and Anderson tends to confirm rather than to contradict Laufer's conclusions.

In his part of their joint paper, Anderson emphasizes the resemblance of the Assamese maize in several characteristics to sorghum, the implication apparently being that this resemblance has some bearing upon the possi-

bility of an Old World origin of maize, since sorghum is undeniably an Old World cereal. Actually the alleged resemblances of Assamese maize to sorghum are either superficial or are examples of the well-known phenomenon of parallel variation which is especially well exemplified among plants by the cultivated cereals and among animals by the rodents.

In the category of superficial resemblances are the isodiametric straw-colored or dull blue kernels. Maize kernels when not crowded tend to be spherical, and the fact that kernels of Assamese maize approach this general shape merely indicates that they are borne on ears on which the kernels are not crowded. This is true of many varieties of South American maize. Furthermore, *any* variety of maize will produce spherical sorghum-like kernels when it bears kernels in the tassel, as practically all varieties are capable of doing when grown in small pots in the greenhouse or when otherwise stunted.

The resemblance in kernel color between the Assamese maize and sorghum is meaningless, since entirely different color-bearing tissues are involved in the two plants. The yellow and blue colors of the Assamese maize are endosperm and aleurone colors respectively and occur in triploid tissue resulting from the process of double fertilization which is characteristic of the Angiosperm seed. The colors of sorghum kernels occur in the pericarp and nucellar layer both of which are diploid maternal tissues (Swanson, 1928). So far as we know, endosperm and aleurone colors have never been reported in sorghum.

The resemblances of Assamese maize to sorghum in lacking anthocyanin pigmentation and in possessing a distinct bloom are nothing more than typical examples of parallel variations in cereals and other cultivated grasses such as sugar cane, in which variations in antho-

cyanin coloration and the presence or absence of bloom are the rule rather than the exception. To find the grayish bloom, one need go no further than corn's closest relative, teosinte.

Finally, to link the Assamese maize with the ancient Bat-Cave corn described by Mangelsdorf and Smith (1949) by comparing both to sorghum is scarcely justified. The Bat-Cave corn resembles sorghum in its small kernels, long glumes, and the fact that the upper glumes are as long or longer than the lower. These, however, are characteristics found in many varieties of pod corn.

To emphasize the resemblance of maize to sorghum or to any other of the Old World relatives of maize without also calling attention to the existence of profound and fundamental botanical differences is to present a misleading picture. Maize does, indeed, resemble sorghum in its general growth habit as well as in chromosome number, and it resembles its Asiatic relatives Coix, Schlerachne, Chionachne and Polytoca in being monoecious. It differs from all of these, however, either in the development of its florets or in the nature of its fruit case. Weatherwax, some years ago (1926), called attention to the superficiality of some of the resemblances between maize and its Oriental relatives. He states:

> In all the Maydeae the fruit is wholly or partly covered by an indurated shell, which is an especially attractive superficial indication of relationship. Its relative absence in Zea may be explained by the unusually complicated covering of husks, or as a result of conscious selection by man. But this general occurrence of a hard shell is a deceptive analogy, rather than a homology. The indurated structure is a combination of a glume and an alveolus of the rachis in Tripsacum and Euchlaena [as well as in Zea], a spathe in Coix, and a glume in Polytoca, Schlerachne and Chionachne. A tendency toward induration of something connected with the fruit seems, therefore, to be all that the genera have in common, and this is possessed by so many other genera of grasses as to be of little significance in determining tribal relationships.

Geographically the Maydeae are sharply divided into two groups, one in each hemisphere, and neither has ever made its way into the field of the other without the help of man. On the other hand, all the genera of each group overlap sufficiently in distribution to suggest an American progenitor and another in Australasia.

Weatherwax might quite justifiably have emphasized even more than he did the close resemblance, morphologically, of maize to its two American relatives, teosinte and Tripsacum. True, its close relationship to teosinte may be of little significance if teosinte is, as has been suggested (Mangelsdorf and Reeves, 1939), a hybrid of maize and Tripsacum. But the resemblance of maize and Tripsacum, an indigenous American species which is widely distributed in both North and South America, is greater than is commonly recognized and is certainly highly significant. In both genera one floret in each pistillate spikelet is suppressed and in both it is the lower floret which undergoes such suppression. In both genera the caryopsis is either enclosed, or surrounded at the base, by a structure which is made up of a segment of the rachis containing an alveolus, and the glumes. In Tripsacum the glumes are indurated while in maize they are often membranous or fleshy, but there is evidence from maize-teosinte crosses that this difference is in some cases a simple Mendelian one of the same general magnitude as that which distinguishes sweet corn from field corn. Maize normally bears paired pistillate spikelets and Tripsacum solitary ones, but paired spikelets have been observed in Tripsacum by Dr. Cutler and solitary spikelets in maize by Hepperly (1949), so that discontinuity between the two plants in these characters is not complete. Maize is an annual and Tripsacum a perennial possessing several characters normally associated with the perennial habit. The distinction is not of profound importance since annual and perennial species are sometimes found within the same genus. The resemblance to

Tripsacum of homozygous pod corn in bearing staminate spikelets above and pistillate spikelets below on the branches of the tassel is especially impressive.

Finally, it is possible, in spite of differences in chromosome number, to hybridize maize and Tripsacum and to demonstrate interchange between their chromosomes. There is abundant circumstantial evidence that such hybridization has occurred in the past and that it has been an important factor in the evolution of maize under domestication.

The closeness of relationship between maize and its American relatives seems to us to be far more important than the fact that maize has a larger number of relatives in Asia than in America.

In short, there is nothing in the botanical evidence of Stonor and Anderson in the three categories considered to invalidate the widely-held and well-supported opinion that maize is an American plant and there is nothing which indicates to us that maize was taken across the Pacific to Asia before 1492.

The Ethnographic Evidence

The ethnographic evidence of Stonor and Anderson, like the botanical evidence, comprises several distinct categories: (a) evidence concerned with legends and traditions; (b) names applied to maize; (c) the uses to which maize is put; (d) the role of maize in the economy of the people.

Stonor in his part of the joint paper gives unwarranted credence, we think, to statements by natives that maize is a very old crop in the region studied. For example: "The Angamis I have talked to simply state that they have grown maize from time immemorial." "The Abor tribes simply state that they have always had maize among their crops." How simplified ethnology would

be if all native informants were indeed as historically reliable as the Assamese are inferred to be. But what a confusing picture of the origin of cultivated plants one would gain by giving credence to such unsupported statements. This conviction on the part of native peoples that they have "always" had a certain plant is by no means confined to the Assamese. Dr. Carl Coons tells us that the natives of Albania are convinced that they have always had tobacco. The native peoples of the Near East are quite certain that they have always had squashes; and Irish peasants, if the question were put to them, would no doubt answer that they have always had the potato. The Indians of Central America are convinced that they have always cultivated the banana, a fact which would undoubtedly be regarded by some as evidence of early trans-Pacific diffusion. But the same Indians, or their neighbors at slightly higher altitudes, are equally sure that they have always had the broad bean *Vicia Faba*, one of Europe's principal leguminous food plants.

Legends to account for the origin of rice are regarded by Stonor as significant, since there is "no legend known to account for the origin of the other cereals; millet, maize and Job's-tears, the inference being that rice is more recent while the others are lost in the mists of antiquity." This is, to say the least, an unusual criterion of ethnological age.

Stonor found distinct names for maize in several of the tribes surveyed and regarded this as "everywhere indicative of a respectable age," and he did not consider the case weakened in instances where the tribal name indicates that it was borrowed from a neighboring people, since "the generalized name could be based on a variety got from the tribe in question and which supplanted older and more indigenous types." The fact that there is no evidence of any kind of "older and more indige-

nous types" seems to be of no importance in answering the question of the antiquity of maize in Assam. Its antiquity seems to be a basic assumption to which the author clings despite conflicting evidence.

Particular emphasis is placed upon the multiple uses of maize among the hill tribes. These are: (1) a catch crop eaten while the grain is soft; (2) stored for winter food either as the main crop or as a reserve secondary to rice; (3) for beer making; (4) for pop corn; (5) for pig food; (6) as an article of trade outside the village.

Obviously the authors do not have a high opinion of the capabilities of pre-literate peoples: "To have these conservative people somehow learning to use maize as a pop corn and as a green corn and as a cereal for brewing, to have them growing types of maize which are similar to each other yet rare or unknown in the New World puts the burden of proof on any one who would ascribe all this development to separate post-Columbian acquisitions."

How else would primitive people be expected to use maize? If they use maize at all they must surely use it for food and once used for food it would be likely to be used both green and ripe, as it is in all other parts of the world where maize is grown. And if the mature maize is small and hard and capable of popping, how much ingenuity is required to put grains of maize "into the glowing embers of the fire," or "in the edge of the house fire" picking them out with bamboo tongs as they burst? How often has the discovery been made independently that small hard kernels of maize will pop when exposed to heat? Is there any greater significance in the fact that the Assamese use maize for popping than in the fact that Asiatic people in general use seeds of species of Amaranthus for that purpose, or the fact that people throughout Latin America use hard-seeded varieties of sorghum, an African plant, for popping?

And what is so strange about using maize for brewing? Practically all of the cereals have been used for brewing in practically all parts of the world where the art of brewing has been practiced. It would be much stranger if the Assamese, "conservative" as they are said to be, did not use maize for this purpose.

Or does the feeding of maize to pigs call for an explanation? Given both maize and pigs, the problem quickly becomes one which the pig itself is likely to solve without much help from man. Domestic pigs have shared in man's principal carbohydrate foodstuffs since time immemorial and no great amount of ingenuity on the part of man is needed to establish this relationship.

The use of maize as an article of trade is too obvious to need comment.

A special use of maize in religious rituals is also regarded as a measure of antiquity. For example: "the dance of the Lakhers, the use of maize in funeral rites among the Lushais in deliberate preference to rice, its importance as a votive offering among the Monbas, the part it plays among the agricultural ritual of the Rengma Nagas, and the existence of a special tutelary deity among the Chang Nagas, all point to its being a well-established crop, the more so since primitive peoples with animistic religion are invariably shy of incorporating new crops into their agricultural ritual." Nor is negative evidence allowed to weaken this case: "I have asked members of the [Monba] tribe if they have any special rites, dances or festivals for their maize, and in all instances this was denied. I would not, however, like to state categorically that my informants were accurate. In dealings with tribal peoples knowledge of religious custom can only be got by long and close acquaintance or direct observation." And, as the author himself admits, "My notes on the religious aspect are particularly scanty." How unfortu-

nate that the author does not display the same admirable caution towards his other kinds of ethnographic data.

The position of maize relative to other crops in the economy of the hill peoples does not seem to us to have the significance which the authors attach to it. Maize, like millet and Job's-tears, is subordinated to rice among peoples living at lower altitudes, but is said to be "of more importance to the tribes living at high altitudes." While we can agree with the authors that this probably is "a state of affairs not unconnected with absence of rice varieties suitable for cold elevations," it is difficult to see how this has any bearing on their case. In view of the ethnological sequence in this region of Asia, it is not surprising to learn that rice is a relatively recent introduction among some of these tribes in spite of the fact that rice is an ancient Asiatic food crop. We cannot, however, put these circumstances together to conclude, as these authors have done, that maize is necessarily pre-Columbian in this region.

Laufer concluded some years ago that maize may have reached China as early as 1540. Goodrich (1938) dates the first Chinese reference to it at 1573. Some 400 years have now elapsed since maize came to Asia. It surely does not tax an anthropologist's credulity to believe that the Assamese and their neighbors, however conservative, have within this period learned or rediscovered or adapted to their own purposes several of the most obvious ways of using maize. Wonder would have been aroused if they had not.

Parallels between Maize in Asia and the Potato in Ireland

To those who are astonished at the extent to which maize is grown in Asia and the number of uses to which it is put and who feel that more than four centuries must

be allowed for the plant to have established itself so firmly in the economy of backward peoples, a study of the history of other cultivated plants may be revealing. Especially illuminating is a recent scholarly treatise by Salaman (1949) on the potato, and of particular interest are those chapters concerned with its history in Ireland.

Introduced into Ireland between 1586 and 1588, the potato had, within fifty years of its introduction, "become the universal and staple article of the peoples' food in the greater part of the island." Many indigenous names were invented for it: *pratie*, *tata*, *murphy*, *croker* and *buntata*. Many superstitions and social and religious customs grew up in connection with its culture. The potato was used not only for food in a variety of ways, but also medicinally and in the preparation of an alcoholic beverage. It was not only food for man, but also provided nourishment for all of his domestic animals, "the pig taking his share as readily as the wife, the cocks, hens, turkies, geese, the cur, the cat, and perhaps the cow — and all partaking of the same dish."

"So completely had the potato woven itself into the web of the life and thought of the people" that they were immune to warnings of crop failures, and "no more attention was given to such warnings than would have been the case had they been told that the rains would cease to fall from heaven." The potato, like the sun and the stars and the rain, had "always" been with them.

It may be argued that the potato became a part of the Irish culture so rapidly only because the Irish were already an advanced people. This apparently is not the case. The state of agriculture in Ireland in the sixteenth century was very primitive indeed and, in Salaman's opinion, it was this very backwardness of the Irish accompanied by general devastation and misery which lead to the breakdown of prejudice against, and the rapid accep-

tance of, a new food. Certainly the potato became much more quickly established in Ireland than in nearby England where it had been introduced even earlier. Also, it is known that both the Germans and the Scots strongly resisted the potato until famine dispelled their prejudice. Perhaps the rapidity with which a new plant is adopted by any people is less a function of their progressiveness than of their need. Seen from this viewpoint, the rapid spread of maize in Asia is not at all astonishing. In the light of the history of the potato in Ireland, post-Columbian time has been ample, and more than ample, for the introduction of maize into Asia and for its establishment as a staple crop.

The Origin of New World Cultivated Cotton and Its Bearing on Asiatic Maize

Stonor and Anderson, to support their argument for an origin or a pre-Columbian distribution of maize in Asia, cite the hypothesis of Hutchinson, Silow and Stephens (1947) which postulates that the New World cultivated cottons are tetraploid hybrids of a wild American diploid, probably *Gossypium Raimondii*, and a cultivated diploid, *G. arboreum*, introduced from Asia by man crossing the Pacific after the invention of agriculture in Asia. This hypothesis has also been cited by others (Carter, 1950; Zelinsky, 1950) as evidence of pre-Columbian trans-Pacific diffusion. It should perhaps be pointed out that many botanists, including the senior author of this paper, although they recognize the hypothesis as stimulating and provocative, are quite critical of it on genetic and botanical grounds. The reasons for this are several.

First, there is no more need of explaining the distribution of the Old and New World cottons in terms of man's peregrinations than there is of accounting for the range of numerous other genera which have a similar

geographic distribution. Indeed, if the differentiation of cotton species is to be explained in terms of man's movements, then there are other genera which are not cultivated, in which speciation ought likewise to be so explained; a procedure which would soon reduce the thesis to an absurdity.

Secondly, their classification of Gossypium, based upon the assumption of a recent origin of the New World tetraploids, is not in harmony with some of the sound taxonomic conclusions of earlier students. For example, the endemic cotton of the Galapagos Islands, formerly regarded as a good species, *G. Darwinii*, is now treated as a variety of the mainland cotton *G. barbadense*.

Finally, the endemic wild tetraploid cotton of Hawaii, *G. tomentosum*, presumably derived from the American tetraploid, presents an almost insuperable difficulty to the entire hypothesis. How could the Hawaiian cotton, in a few thousand years or less, have become so differentiated from the mainland allotetraploids that it is now generally regarded as a distinct species, since it differs in many characteristics, and since there is a high incidence of seedling mortality in the F_2 when *G. tomentosum* is crossed with the American species *G. hirsutum*. The genetic gap between the Hawaiian tetraploid and the American tetraploids is perhaps a fourth to a half as great as the gap between the American and Asiatic diploids, yet the differentiation in the one case is supposed to have required only a few thousand years, in the other, since it is assumed to have begun in the Cretaceous, some 120 million years. Differentiation of species does not, of course, proceed uniformly in time and space and the degree of differentiation is not a reliable measure of time. Yet it is difficult to believe that the rate of speciation within the same genus, and involving in part the same chromosomes, could have been roughly ten thousand

times as rapid in one period as in another. The difficulty is rendered more acute by the necessity of assuming that differentiation has been more rapid in the tetraploids than in the diploids. Few serious students of evolution will accept this premise.

In our opinion, the taxonomically distinct, wild, endemic, tetraploid cotton of Hawaii presents, for the moment at least, an insuperable obstacle to the acceptance of the conclusions of Hutchinson, Silow and Stephens. The case for the trans-Pacific, pre-Columbian diffusion of Old World cultivated cottons is no better, in our opinion, than the case for an Asiatic origin or pre-Columbian diffusion of maize. To use the one as evidence in support of the other, is to assume that two guesses have, through some strange alchemy, a greater validity than one.

Conclusion

We can find nothing in either the botanical or ethnographic evidence presented by Stonor and Anderson on Assamese maize to justify their conclusion that maize must either have originated in Asia or been taken there in pre-Columbian times. The maize itself is not unique, since it resembles the living varieties of Colombia and thus conforms to the general rule that all Old-World maize has its counterparts somewhere in America. The uses to which maize is put in Assam are exactly those to which one would expect such a cereal to be put when introduced into Asia, and there are no other special circumstances about its utilization, or the traditions connected with it, which indicate a great antiquity in Asia. The fact that maize, if introduced into Asia in post-Columbian times, must have been rapidly accepted by backward people, merely indicates that, like the potato in Ireland, it met an acute and pressing need. Cer-

tainly there is nothing in the evidence which is in conflict with the long-established and well-supported opinion that maize is an American plant—one which has perhaps been introduced into Asia twice: once in early post-Columbian times from the west by a land route, and a second time, perhaps somewhat later, when tobacco and the potato were also introduced from the east by seafaring people. There is no factual evidence in conflict with this simple and rational explanation; but there is abundant evidence to support it.

The door is still wide open for hypotheses about pre-Columbian culture diffusion between the Old World and the New, and the problem is an extremely important one which merits the most careful and critical attention on the part of scholars in several fields. The problem is not likely to be solved, however, by putting forward sweeping and sensational conclusions which are based upon inadequate and fragmentary evidence, especially when these are all too likely to be seized upon by other imaginative writers who treat them as "evidence" or, worse still, as "virtually unassailable proof" (Zelinsky, 1950).

Perhaps there has, indeed, been a pre-Columbian, trans-Pacific diffusion of culture and perhaps maize has been involved in it. To speculate upon this possibility certainly can do no harm. But fancy ought not to be confused with fact. The *fact* is, that, at the present time, there is no tangible evidence of any kind — botanical, archaeological, ethnographic, linguistic, ideographic, pictorial or historical — of the existence of maize in any part of the Old World before 1492. Until such evidence is discovered, any case for pre-Columbian, trans-Pacific diffusion must rest on evidence other than maize.

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